

# **Alberta's Wetlands: Water in the Bank!**



**A Discussion Paper Prepared for the  
Alberta Conservation Strategy Project**

# Alberta's Wetlands: Water in the Bank!

Prepared by

Robyn Usher, Environment Protection Subcommittee  
of the Public Advisory Committees to the Environment Council of Alberta

Jonathan Scarth, Resource Lawyer, Atkinson  
McMahon Barristers and Solicitors, Calgary

Published by  
Environment Council of Alberta

October 1990



Distributed without charge as a public service.



Original printed on recycled paper

Additional copies of this publication may be obtained from:

Environment Council of Alberta  
8th Floor Weber Centre  
5555 Calgary Trail Southbound NW  
Edmonton, Alberta  
T6H 5P9

Phone (403) 427-5792  
Fax (403) 427-0388

Orders may also be placed through our electronic bulletin board at (403) 438-5793 (24 hours per day).

*This report is published as a public service. The opinions expressed in this report are those of the author(s) and do not necessarily reflect the views of the Environment Council of Alberta.*

This report may be cited as:

Usher, R. and J. Scarth. 1990. *Alberta's Wetlands: Water in the Bank*/ ECA90-PA/CS-S14.  
Environment Council of Alberta, Edmonton.

ECA90-PA/CS-S14

---

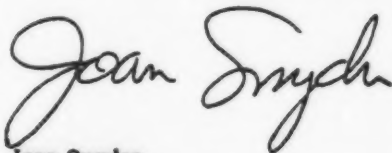
## FOREWORD

In late 1985, the Public Advisory Committees to the Environment Council of Alberta began working toward a draft conservation strategy for Alberta. The Public Advisory Committees (PACs), comprising representatives of some 120 non-government organizations, are in many ways an ideal organization for developing a strategy that should touch the lives of all Albertans. The PACs bring together many diverse viewpoints, we are non-partisan, and we have members from across the province. Since the early days of the project, we have welcomed non-PAC participants, and have been delighted to receive the contributions of civil servants, industry spokespeople, academics, and the general public.

We have made progress since 1985: the *Prospectus for an Alberta Conservation Strategy* has been published and many meetings and workshops have been held. The principle of a conservation strategy increasingly has been endorsed by Albertans, and Alberta has been recognized across Canada as a leader in conservation strategy development. There have been important related events. For example, in September of 1987, every environment minister in Canada endorsed the final report of the National Task Force on Environment and Economy, which recommended that conservation strategies be in place in every province and territory by 1992. This same report was endorsed by the First Ministers at their November, 1987 meeting.

Since the publication of the *Prospectus*, the PACs have concentrated on preparing sectoral discussion papers. The Conservation Strategy Steering Committee determined early on to produce background papers on relevant sectors, such as agriculture, fish and wildlife, tourism, oil and gas, and others. These discussion papers look at the issues within each sector, but, more importantly, they investigate the interaction of each sector with the others. Their preparation has involved consulting with a wide range of interest groups — a conservation strategy principle in action — which has proven fruitful in developing ideas about the ultimate conservation strategy. These discussion papers will be used as background information for drafting a conservation strategy document. This report is one in the series of discussion papers.

Because there are as many opinions on our best future direction as there are Albertans, we welcome comments. The conservation strategy will be only as good as the work that goes into preparing it. Please address any comments on this discussion paper or others in the series to the Environment Council of Alberta at the address given on the page opposite. I would also encourage you to make your opinions known at public hearings, consultations, or other events which relate to sustainable use of our resources. Let's treat Alberta as if we plan to stay!



Joan Snyder

Chairperson

Conservation Strategy Steering Committee

Public Advisory Committees to the Environment Council of Alberta

## ABOUT THIS DISCUSSION PAPER

Glaciation in western Canada left Alberta with innumerable ponds and sloughs characterized by an abundance of animal and plant life and supported by nutrient-rich soil. As agriculture in western Canada expanded, fertile wetland soil was converted to farmland; wetlands, with the life they supported, then began to disappear. Where these wetlands still exist, they are among the province's most productive ecosystems.

*Alberta's Wetlands: Water in the Bank* attempts to demonstrate the importance of Alberta wetlands by first defining the nature, location, and benefits of wetland functions and then describing the current activities of the various sectors of Alberta's society and economy that contribute to wetland loss.

This sector report also attempts to further the goal of achieving sustainable use of Alberta's wetlands by surveying existing wetland evaluation techniques and the many legislative regimes that affect wetlands. The conclusion of this report contains recommendations for overcoming the three obstacles to achieving sustainable wetland use: lack of knowledge about wetland functions and benefits; lack of quantitative data on the value of wetlands; and competing legislative regimes.

The points raised in this discussion paper are meant to generate ideas and discussion among the many interested and affected parties. If Albertans are to continue to enjoy the many benefits provided by wetlands, then a wetland management policy is needed to ensure sustainable wetland use.

## ABOUT THE AUTHORS

Robyn Usher, the author of *Alberta's Wetlands: Water in the Bank*, is the principal of GAIA Consultants Environmental Planning & Communication, Calgary. Jonathan Scarth provided the information contained in Chapter Five: Legislative Regimes. Mr. Scarth, a resource lawyer with Atkinson McMahon Barristers and Solicitors of Calgary at the time this report was written, is now Secretary to Cabinet for the Policy Management Secretariat, Government of Manitoba.

## ACKNOWLEDGMENTS

*Alberta's Wetlands: Water in the Bank* is a better document as a result of the reviews and assistance of several individuals and agencies. Their ideas are reflected in the report and they share in its accomplishments. Any errors or shortcomings remain the responsibility of the authors.

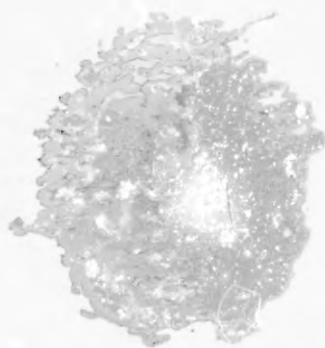
The Policy Secretariat of Alberta Forestry, Lands and Wildlife and the Water Resources Commission reviewed early drafts and provided valuable suggestions. In particular, we would like to recognize the contribution of Leonard Swanson, who was employed by the Water Resources Commission at the time this paper was being prepared. Thanks are extended to Steve Zoltai of the Northern Forest Research Centre, Bob Scace of Beak Associates Consulting Ltd., and Wayne Cowan of Ducks Unlimited for providing valuable perspectives and ideas.

The encouragement and assistance of the Environment Council of Alberta are also appreciated, especially the efforts of two of the council's research staff, Calvin Webb and Mike Kelly (now of the Secretariat to the National Round Table on Environment and Economy), and the council's editor, Elizabeth Alke.

---

# Contents

|                                                                          |           |
|--------------------------------------------------------------------------|-----------|
| <b>Wetlands in Alberta .....</b>                                         | <b>1</b>  |
| Introduction.....                                                        | 1         |
| Ramsar Convention .....                                                  | 1         |
| The Alberta Conservation Strategy .....                                  | 1         |
| Sector Report Objectives .....                                           | 2         |
| Wetlands Defined.....                                                    | 3         |
| Location of Alberta Wetlands.....                                        | 4         |
| Wetland Status .....                                                     | 5         |
| <b>Environmental, Economic, and Social Significance of Wetlands.....</b> | <b>8</b>  |
| Environmental Wetland Benefits .....                                     | 8         |
| Economic Benefits .....                                                  | 11        |
| Social Benefits .....                                                    | 12        |
| Summary.....                                                             | 13        |
| <b>Interactions With Other Resource Sectors .....</b>                    | <b>14</b> |
| Fish and Wildlife .....                                                  | 14        |
| Agriculture.....                                                         | 15        |
| Forestry .....                                                           | 17        |
| Nonrenewable Resources .....                                             | 17        |
| Tourism, Parks, and Outdoor Recreation.....                              | 18        |
| Urban Environment .....                                                  | 18        |
| <b>Assessing Wetland Benefits.....</b>                                   | <b>20</b> |
| Wetland Valuation Approaches .....                                       | 21        |
| Discussion.....                                                          | 24        |
| Conclusions .....                                                        | 24        |
| <b>Legislative Regimes .....</b>                                         | <b>25</b> |
| Federal Legislation .....                                                | 25        |
| Provincial Legislation .....                                             | 28        |
| Conclusions .....                                                        | 31        |
| <b>Conclusions.....</b>                                                  | <b>32</b> |
| <b>References .....</b>                                                  | <b>34</b> |



---

## Chapter One

# Wetlands in Alberta

**W**etlands are among the world's most productive environments. They provide tremendous economic benefits to mankind through the maintenance of water tables for agriculture, water storage and flood control, shoreline stabilization, timber production, waste disposal and water purification, and recreational opportunities (Ramsar Convention).

### Introduction

Wetlands are one of the earth's most precious land resources. More than any other natural landform, wetlands, which include marshes, prairie potholes, bogs, and fens are "working landscapes whose ecosystems meet a remarkable variety of basic human needs, ecologically and economically" (Working Group on International Wetlands 1988). Wetlands buffer the effects of floods, storms, and droughts, purify the water of entire watersheds, provide habitat for thousands of plant and animal species, and use energy with an efficiency that rivals the most productive croplands.

These functions make wetlands enormously important in all parts of the world. Yet over the years, largely through human activities, wetlands have been substantially reduced. In Europe and North America, over 50 percent of the original wetland base has been lost due to human actions (Working Group on International Wetlands 1988). More specifically, in Canada, 71 percent of prairie wetlands have been lost primarily to agriculture (Lands Directorate 1986). A corresponding loss (75 percent) has occurred in the Prairie Pothole Region of the

United States where wetlands have been drained and converted to agricultural uses (Jahn 1988).

Significant efforts are now being expended to understand and protect wetland resources. Albertans need to become aware of these efforts so that they can better appreciate the level of national and global concern about wetlands and see their own conservation efforts as part of the solution.

### Ramsar Convention

Canada is party to the International Convention on Wetlands of International Importance, known also as the Ramsar Convention. This convention was inaugurated in 1975 and is the first modern global convention to provide a framework for international cooperation in conserving wetland habitats. As a party to the convention, Canada has undertaken to promote the wise use of wetlands and to designate at least one wetland of international importance. To date, Canada has designated 17 sites (200,000 square kilometres) for protection. Selection of protected sites is based on international significance in terms of ecology, botany, zoology, limnology (water chemistry), and hydrology (water properties, distribution, and circulation) (IUCN 1987).

### The Alberta Conservation Strategy

The Alberta Conservation Strategy, to which this sector report on wetlands belongs, owes its origin to the World Conservation Strategy (WCS). Published in 1980 (IUCN 1980), the WCS represents five years of work on the part of more than 450 agencies and organizations including national governments, development agencies,

international aid organizations, nongovernment environmental groups, and scientists who met to discuss the global problem of renewable resource depletion and the pressing need for conservation. The resulting World Conservation Strategy argues that if we are to have a sustainable future, economic activity must be based on sound environmental management. Canada endorsed the WCS in 1981 through the federal minister of the environment.

In 1986, Canada hosted the World Conservation Strategy Conference. This conference concluded that sustainable use depends on strategies and actions that realize the potential of natural, human, and other resources in ways that maintain and enhance human well-being. It was agreed that conservation strategies and actions should comply with the three principal objectives of the World Conservation Strategy.

**Table 1**

**World Conservation Strategy Objectives**

**Objective 1:** To maintain essential ecological processes and life-support systems (such as soil regeneration, nutrient recycling, and cleansing of coastal and fresh waters) on which human survival and development depend.

**Objective 2:** To preserve genetic diversity including the tremendous range of plant and animal species that make up the planet's life. These species are capable of providing important agricultural, forestry, and fisheries products and are vital parts of the life systems on which we depend.

**Objective 3:** To achieve sustainable use of species and ecosystems (most notably fish, wildlife, forests, agricultural soils, and grazing lands) that support many important industries such as agriculture, forestry, fish and wildlife harvesting, and tourism.

Following the WCS conference, the Canadian Council of Resource and Environment Ministers, now the Canadian Council of Ministers of the Environment (CCME), established the National Task Force on Environment and Economy. The purpose of the task force was to initiate dialogue between

governments, industry, environmental organizations, and academic institutions on the subject of integrating environmental concerns with economic policies. One of the many recommendations made by the task force was that all provinces complete conservation strategies by 1992.

**Sector Report Objectives**

In view of the World Conservation Strategy objectives and recommendations, the authors of this report propose the following definition for sustainable wetlands in Alberta.

Use of wetlands is sustainable when the provincial wetland base ensures that essential wetland ecological processes are maintained while also meeting the economic and social needs of Albertans.

There are many obstacles to achieving sustainable wetland use in Alberta. This report attempts to address three of them: lack of understanding about wetland functions and benefits, lack of quantitative data on the value of wetlands, and competing legislative regimes.

Poor understanding of wetland functions, their importance, and the extent of wetland benefits has led to their loss and degradation. The first objective of this report is to help overcome this lack of understanding. Chapter One describes what wetlands are, where they are, and current wetland status. Chapter Two surveys the environmental, economic, and social benefits derived from wetland functions, and Chapter Three identifies the impacts of other resource sector activities on essential wetland functions.

Without a definitive system for assigning numerical or dollar value to wetland functions and benefits, wetlands are difficult to defend when threatened by alternative use or conversion. Chapter Four addresses this second obstacle to sustainable wetland use by exploring the inherent difficulties in pricing, or measuring,

wetland benefits. It also surveys tried wetland evaluation methods in the hope that Albertans will compare and consider the strengths of each approach.

Finally, Chapter Five explores competing legislative regimes, the third obstacle to sustainable wetland use. If sustainable wetland use is to be achieved, then public will must be empowered by cohesive legislation. This legislation will need to reflect an integrated, inclusive management plan for wetlands similar to that identified in the *Draft Alberta Conservation Strategy: Strategic Framework in Brief*.

Chapter Six offers recommendations intended to motivate Albertans to begin to take action to remove these three critical obstacles and to progress toward sustainable use of Alberta's wetland resources.

## Wetlands Defined

Considerable effort has been spent by many agencies and organizations in developing wetland classification schemes. Most notable in this regard are Stewart and Kantrud (1971), Millar (1976), and the National Wetlands Working Group (NWWG) (National Wetlands Working Group 1987). The NWWG have developed a national wetlands classification scheme that has been applied and tested throughout Canada in both local and regional studies and represents a synthesis of existing systems (Table 2). It was chosen for use in this report for three main reasons: it is national in scope; it promotes an ecological approach to wetland management; and the five major wetland types identified by the scheme — bogs, fens, swamps, marshes, and shallow water — are easily recognized. All five major wetland types occur in Alberta.

Reference is also made in this report to wetlands of varying degrees of permanence. This further classification is necessary because many of Alberta's wetlands do not retain water throughout the entire year. Some wetlands, for example, retain water only temporarily in spring. These wetlands are primarily small, shallow

**Table 2**  
**Wetland Types**

**BOGS**— Bogs are peatlands carpeted with mosses, chiefly sphagnum, which can range in colour from pale green to deep red. Bogs are usually covered with low shrubs and many contain such plants as the sundew or pitcher plant, cranberry, various sedges, and cotton grasses, and may be treed with black spruce or tamarack. The water table is generally at the surface in the spring and slightly below ground for the rest of the year. Bogs are fed only by rain and snow and as a result become highly acidic. The upper peat layers are nutrient and oxygen poor.

**FENS**— Fens are also peatlands, but the dominant plants are sedges accompanied by grasses, brown mosses, and flowers such as iris. Often there are shrubs and cedar or tamarack trees. Fens are fed by streams or groundwater so they are less acidic than bogs. The water table is usually at or above the surface. The water in a fen is generally richer in nutrients than that of a bog, but poorer than that of swamps and marshes. Even to the trained eye, it is often difficult to distinguish a bog from a fen.

**SWAMPS**— Swamps are wetlands where the water is either standing or gently flowing through pools and channels. Swamps are sometimes referred to as wetland forests or wooded wetlands. A forest swamp includes mature trees such as maple, elm, white cedar, tamarack, and black spruce. A thicket swamp is characterized by tall shrubs such as willow, dogwood, and alder. The ground is usually covered with herbs and mosses.

**MARSHES**— Marshes are areas that are either permanently or periodically inundated by standing or slowly moving water. Typically, marshes are divided into channels and pools by stands of cattails, rushes, sedges, and grasses and are bordered by grassy meadows and bands of shrubs or trees. Cattails, arrowhead plants, and water lilies are familiar marsh sights.

**SHALLOW WATER**— Shallow water wetlands are distinguished by midsummer water depths of two metres or less. Typically these wetlands are wide, flat basins variously called ponds, pools, shallow lakes, or oxbows. Periodic flooding may increase water depths, but during periods of drought, low flows, or drainage, mudflats are usually exposed.

Source: Adapted from the National Wetlands Working Group (1987)

depressions that hold water intermittently after snowmelt. Semipermanent wetlands are larger and deeper; they hold water until the early part of summer when seasonally hot weather

frequently dries them out. Permanent wetlands are by far the largest and deepest wetlands; because of their size and depth they retain water throughout dry summer weather.

Most provinces, including Alberta, have developed their own wetland classification schemes that are specific to provincial needs. In Alberta, the Alberta Water Resources Commission (AWRC) conducted a reconnaissance level inventory of wetlands only in the White Area, or agricultural areas, of the province as part of their Agricultural Land Base Study. The AWRC study identifies seven major wetland types, dividing them into nonpermanent and permanent categories (Table 3). Although the AWRC system is not used in this report it is worthy of inclusion because it was developed specifically for Alberta and serves to broaden awareness of the variety and pervasiveness of wetland types within the province. The principal difference between the NWWG scheme and the AWRC study is the greater number of categories recognized by the AWRC system and its inclusion of both lakes and streamcourses.

### Location of Alberta Wetlands

Wetlands occur in all ecoregions of Alberta. Ecoregions are ecological zones that are characterized by distinctive patterns of vegetation and landform. In Alberta, there are 12 ecoregions; they include a range of dominant forest, parkland, and grassland vegetation types. According to the NWWG scheme, approximately 21 percent or 2,395,000 hectares (5,917,964 acres) of the province's land base of 60,118,793 hectares (148,556,771.8 acres) is wetland. Wetland concentration in Alberta is shown in Figure 1.

The Alberta Water Resources Commission survey (1987), which is more inclusive than the NWWG system, estimated that there are approximately 4,856,400 hectares (12 million acres) of wetland distributed throughout the province's agricultural areas (White Area). Wetlands, as identified by the AWRC, represent 20 percent of the province's total agricultural

**Table 3**  
**Alberta Water Resources Commission**  
**Wetland Classification System\***

#### Nonpermanent Wetlands

**Nonpermanent slough/marsh**—Wetland in a depression where surface drainage is obstructed, with less than 50 percent of the area as open water. Surface water is not always present; the area is usually dry for part of the growing season, especially in late summer and fall.

**Sheetwater**—Areas of relatively flat, nonsloping terrain that are periodically inundated by shallow, open water that persists for short periods.

**Seep**—Wet areas resulting from groundwater discharge at the soil surface.

#### Permanent Wetlands

**Permanent slough/marsh**—Same description as for nonpermanent slough/marsh except that surface water is present year-round or climax vegetation is present.

**Lake/pond**—Permanent body of open water.

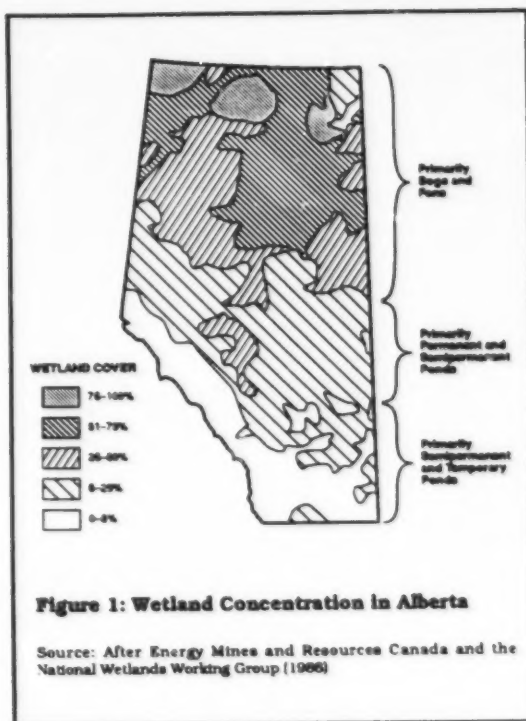
**Bog/fen**—Areas composed mainly of peat or sedge and organic materials.

**Watercourse**—Channel for running water and adjacent floodplain.

\* The AWRC study further describes wetlands according to watershed position, form (e.g., deep depression, shallow depression, channel, basin), wetland ground cover, upland ground cover, chemistry, and degree of disturbance (e.g., undisturbed, drainage, irrigation, grazing).

land base. Seventy-five percent of this wetland acreage is located in five northern river basins: the Battle, North Saskatchewan, Beaver, Athabasca, and Peace. In these five basins, nonpermanent wetlands occupy 809,400 hectares (2 million acres) and are considered to have a high potential for drainage.

Permanent bogs and fens, according to the AWRC, cover about 2,225,850 hectares (5.5 million acres) and constitute the remaining wetlands in the White Area. Approximately half of these permanent wetlands are considered drainable with current technology. A wetland inventory of the primarily forested Crown lands that comprise the Green Area of the province has not yet been undertaken.



Most of Alberta's wetlands are located in the northern third of the province in northern forested ecoregions. These wetlands consist mainly of permanent bogs and fens. Wetlands in the middle third of the province also occur in forested regions and include not only bogs and fens, but also swamps and marshes. In the southern third of Alberta, wetlands occur in the parkland and prairie grassland ecoregions. Permanent and semipermanent ponds and marshes are typical of the aspen parkland ecoregion; and, temporary and semipermanent ponds and saline and freshwater marshes characterize the grassland ecoregion (Environment Canada 1981).

## Wetland Status

### North America

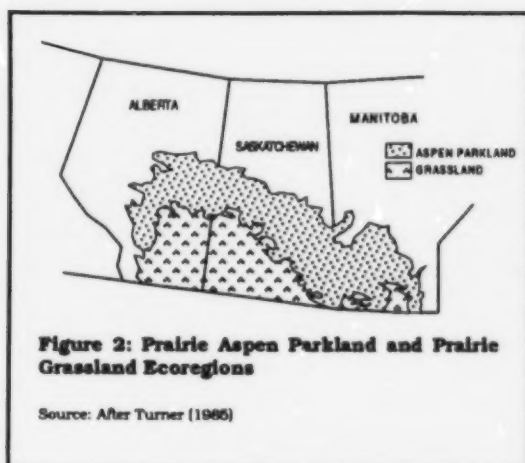
Since European settlement, wetland loss has occurred throughout North America at an alarming rate and agriculture has been identified

as the continuing major cause. In the prairie provinces alone, approximately 1.2 million hectares (3 million acres) of wetland habitat have been converted to agricultural use since settlement (Bellrose 1976). The Lands Directorate of Environment Canada (1986) estimates that 65 percent of Atlantic coastal marshes, 70 percent of southern Ontario wetlands, up to 71 percent of prairie wetlands, and 80 percent of the Fraser River Delta in British Columbia have been lost due to agricultural expansion. A similar situation exists in the United States, where 75 percent of prairie wetlands have been drained and converted to agricultural uses (Jahn 1988).

### Prairie Canada

The history of wetland status in Manitoba, Saskatchewan, and Alberta is very similar. Drainage of wetlands began in the late 1800s with settlement. A first drainage peak was experienced at the beginning of the century as prairie grasslands were converted to crop and forage production. Drainage activity declined during the drought of the 1930s, but accelerated again in the 1940s. In the mid-1950s, with the advent of larger farm equipment, wetland drainage expanded to include wetlands more difficult to drain. This trend has continued to the present and now includes drainage of wetlands on marginal agricultural land.

Wetland loss in prairie Canada has been documented by a number of studies. Goodman and Pryor (1972), working in the Black Soil Zone (that area of the aspen parkland and grassland ecoregions characterized by dark-coloured soils containing a deep, rich humus layer) of the prairie provinces, estimated wetland loss due to total drainage at 42 percent before 1950, and an additional net loss of 25 percent thereafter. Schick (1972), estimated that a 61 percent net loss of wetlands occurred in the aspen parkland ecoregion of Alberta between 1900 and 1970, and Schmitt (1980) estimated that Alberta's South Saskatchewan River basin suffered a 21 percent loss of wetland habitat between 1800 and 1979.

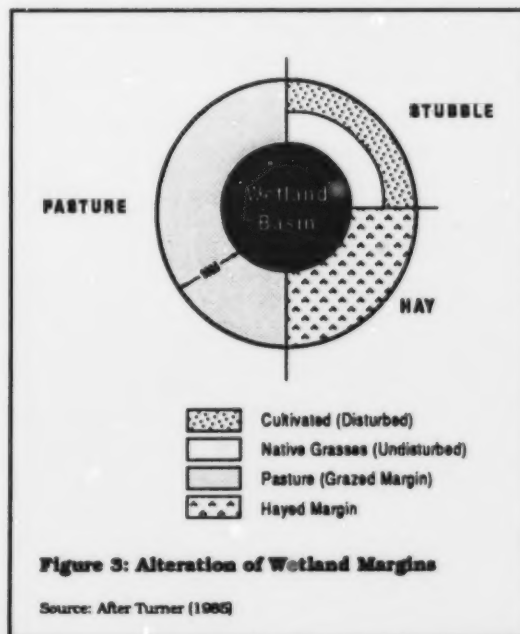


**Destruction of Prairie Wetland Basins** — Surveys conducted by the Canadian Wildlife Service (CWS) (Brace and Pepper 1984) indicate that draining, filling, and cultivating of semipermanent and permanent wetland basins is currently occurring in the prairie provinces at a rate of 18 percent per year. Data indicate that the rate of wetland destruction is greatest in Saskatchewan (21 percent), and next greatest in southern Alberta (13 percent), followed by southern Manitoba (11.5 percent). Before 1970, wetland drainage in Alberta and Manitoba exceeded that of Saskatchewan. The higher rate recently reported for Saskatchewan represents a catch-up situation. Consequently, drainage practices in the other two provinces should not be construed as more moderate.

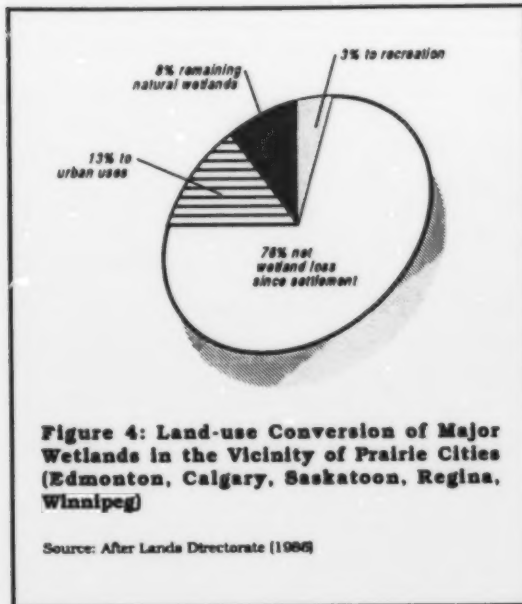
**Alteration of Prairie Wetland Margins** — The same CWS survey also found that intensive farming practices such as burning, clearing, grazing, and cultivating have serious impacts on prairie wetland margins. Between 1981 and 1983, these practices affected 61 percent of permanent and semipermanent wetland margins across the prairies (Brace and Pepper 1984). Wetland margins are consistently altered at a higher rate than wetland basins. Loss of important wildlife habitat is just one consequence of altering wetland margins; many wetland functions important to human well-

being are also impaired by such action. Figure 3 provides a schematic representation of a wetland basin and some ways in which altered wetland margins are used.

Turner et al. (1987) measured agricultural impacts on wetland margins in the Canadian prairies over a period of five years (1981-1985) and found a distinctive spatial pattern when disturbance was analyzed by province. The occurrence of degradation of wetland margins increased from Manitoba in the east to Alberta in the west. The average rate of impact on wetland margins was 64 percent in Manitoba, 78 percent in Saskatchewan, and 93 percent in Alberta. The lower incidence of impact in Manitoba can be partly explained by the distribution of wetlands by ecoregion. Eighty-three percent of wetlands in Manitoba, compared with 60 percent in Saskatchewan and 63 percent in Alberta, occur in the parkland ecoregion where wetlands are generally less susceptible to drought and encroachment by cultivation and grazing, than wetlands in the grassland ecoregion (Figure 2). Over the five-year period of the study, an average of 79 percent of the wetland margins and 59



percent of the wetland basins on Canadian prairies were degraded by agricultural practices.



**Urban Encroachment** — The proximity of wetlands to agricultural and urban areas coupled with increasing development demands has made land underlying wetlands economically valuable. The draining, dyking, and filling of wetlands has made it possible to expand the agricultural land base. Wetlands have been similarly converted to accommodate urban and industrial expansion. Although not as extensive as agricultural expansion, urban and industrial development have resulted in the continued and irreversible conversion of wetlands for uses such as shopping centres, airports, and landfill sites. It is estimated that by 1981, up to 76 percent of the original wetland base in the vicinity of Edmonton, Calgary, Saskatoon, Regina, and Winnipeg had been converted to agricultural uses; 13 percent to urban uses; and less than three percent for recreational purposes (Lands Directorate 1986) (Figure 4).

## Environmental, Economic, and Social Significance of Wetlands

**M**any good wetlands have been altered to other uses simply because their value to society could not be adequately demonstrated (Wildlife Habitat Canada and the Canadian Wildlife Service).

Throughout much of human history, wetlands have been regarded as wet, unsavoury places with little or no value. The truth is, wetlands meet a remarkable variety of basic human and ecological needs.

Erosion control, aquifer recharge, water quality maintenance, and provision of plant and animal habitat are some of the important environmental functions that wetlands perform. When left in their natural state, wetlands also provide many economic benefits. For example, they supply water for domestic and industrial use; improve the quality of that water supply; and provide habitat that produces and protects wildlife species of economic and recreational importance. Derived social benefits include esthetic needs for open space and landscape variety, recreational activities, and research and educational opportunities.

### Environmental Wetland Benefits

#### Climate Modification

By modifying the temperature and moisture content of the lower atmosphere, wetlands can influence local or regional weather and climate. Evaporation and release of water vapour from wetland plants (evapotranspiration) provides a source of water to the atmosphere leading to local cloud formation and precipitation. The

precipitation regulated by wetlands is often an important source of moisture for prairie farmland.

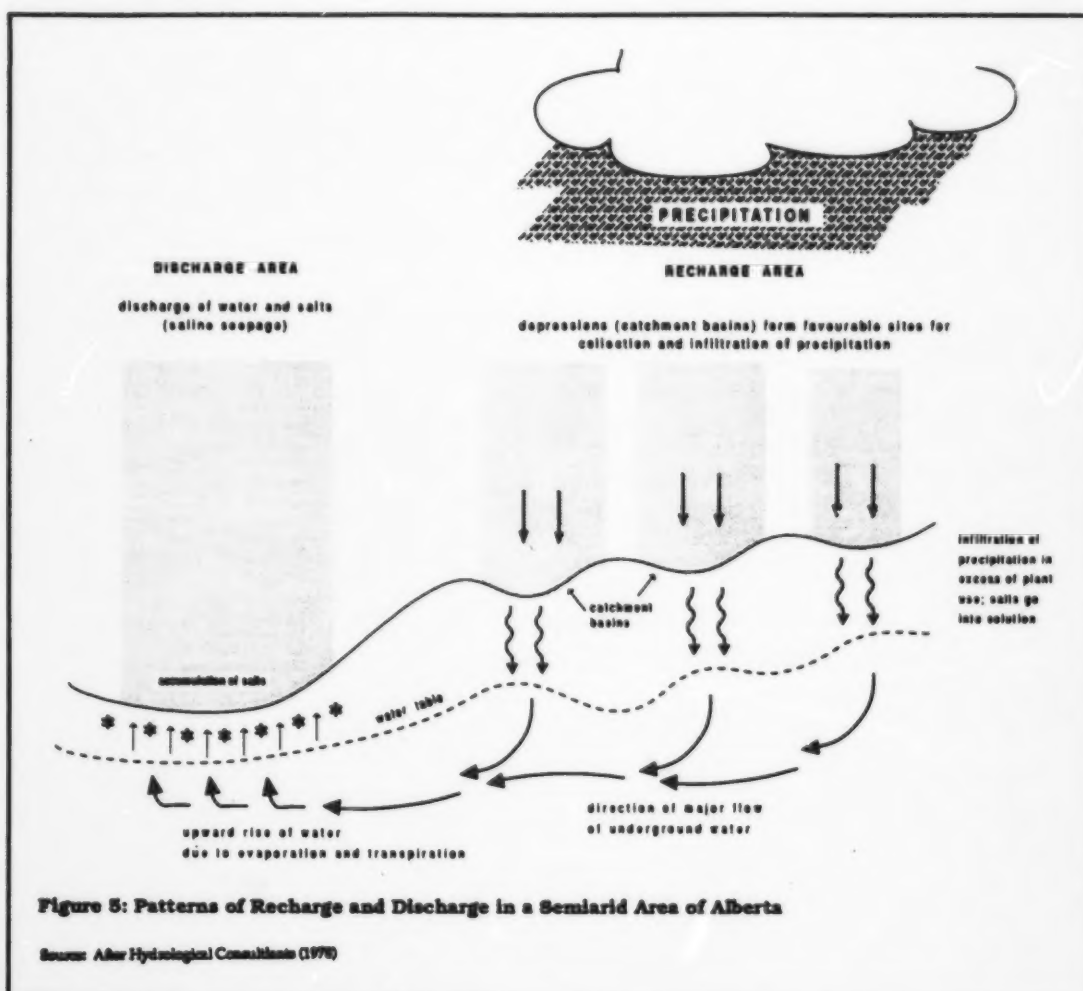
Wetlands also contribute to atmospheric stability by storing carbon and releasing methane and by converting potentially harmful nitrous oxide to other chemical forms of nitrogen.

#### Erosion Control

Wetlands reduce soil erosion and lessen its consequences in many ways. Catchment basins, for example, collect spring and summer runoff. By retaining a portion of these seasonally high waters, allowing them to spread over a wide area, and slowing the rate at which water is released into rivers and streams, wetland catchment basins diminish the effects of downstream flooding.

Wetland catchment basins also collect soils that would otherwise be lost to flooding. Eroding soils that settle out of floodwater remain in catchment basins after much or all of the water has disappeared. A recent joint study by Alberta Agriculture and Agriculture Canada estimated that the cost to Alberta farmers of replacing topsoil lost through water erosion could be as high as \$90 million (Western Producer 1987).

Water retention by catchment basins is also important in maintaining base streamflows. Under normal conditions catchment basins hold water, allowing it to seep slowly into the soil. This water enhances underground water supplies used as rural water sources, and feeds streams and rivers via underground movement of water through soil and bedrock (Figure 5).



## Water Quality

The sediment-reducing function of wetlands provides many benefits. Trout and salmon, for example, require clear, fast-running water for feeding, spawning, and essential oxygen exchange. Heavy siltation not only reduces the amount of available oxygen in rivers and streams, it impairs visibility, covers the gravel beds where fish spawn, and affects the availability of the other organisms that fish feed on.

Reduction of sediment loads delivers another significant benefit. Nutrients such as nitrogen and phosphorus, as well as toxins including heavy metals and pesticides, tend to

become attached to soil particles. By lowering the amount of sediment distributed throughout the water column, wetlands reduce the impurities available for dissolution.

Many wetland plants also absorb excess nutrients. This function prevents the over-enrichment of water that would otherwise encourage the growth of oxygen-demanding algae. Oxygen-depleted waters in turn have an impact on the well-being of other dependent populations, including humans. High nitrate concentrations in drinking water, for example, can inhibit the blood's ability to obtain essential oxygen.

### Waste Management

The economic and social benefits of wetland water quality and erosion control functions are becoming increasingly evident to the administrators of towns and cities. Two experiments with natural and artificial wetlands have demonstrated their potential for ensuring water quality. The town of Humboldt, Saskatchewan (population 5,500) experimented with the use of a man-made marsh to purify its water. San Diego, California now uses an artificial wetland system that converts waste water into drinking water; the current system purifies 1,000,000 gallons of water a day, and expansion of this capacity is planned. Both centres are experiencing substantial savings in their waste water management expenditures.

### Habitat

For many animal species, wetlands provide food, breeding sites, resting areas, nesting materials, nesting sites, moulting grounds, and protection from weather and predators. About 45 species of waterfowl, 115 of other birds, and at least 50 fur and game species such as grouse, rabbit, deer,

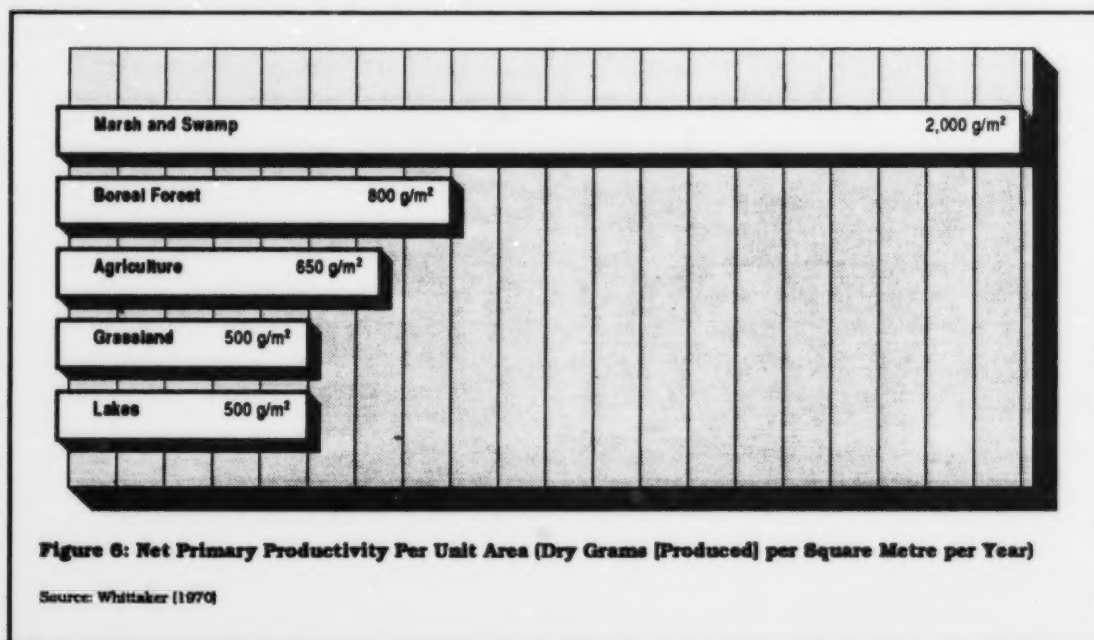
beaver, mink, and muskrat use North American wetlands for at least part of each species' life cycle (Cowan 1982). Wetlands also support large and diverse communities of insects that provide food for waterfowl, marsh birds, and fish. In a single Alberta wetland, a total of 342 species of invertebrates have been found (Acorn 1987).

### Food Production

Wetlands provide habitat for a wide variety of plants and animals and are highly productive, supporting complex food webs. The biotic density and diversity of wetlands is frequently much greater than the adjacent uplands. Whittaker (1970) estimated the net annual production of marshes and swamps as 2000 grams per square metre and boreal forest, the next most productive habitat, as 800 grams per square metre (Figure 6).

### Species Protection

Wetlands provide habitat for rare and endangered species. For example, the piping plover (*Charadrius melodus melodus*) is listed by the Committee on the Status of Endangered Wildlife in Canada as an endangered species



because of wetland habitat loss. Fewer than 100 pairs of piping plovers remain in Alberta (Weslow and Weslow 1983; Werschler and Wallis 1987). The species has all but disappeared in Manitoba (Recce 1984).

### **Economic Benefits**

Wetlands are tremendously productive. The net annual primary productivity (i.e., the dry weight of plant material produced per square metre per year) of a marsh, for example, is two or three times that of the best agricultural land. This is because the shallow, sluggish water of a marsh favours bacterial growth, rapid decomposition, and a short turn-around time for nutrient recycling. Nutrient-rich wetlands support a diversity of plants ranging from billions of microscopic algae to tall cattails. These plants in turn provide food and habitat for hundreds of animal species, many of which depend on wetlands for some or all of their principal life requirements.

The value of the commercial harvest of wetland species is substantial; it includes such diverse activities as commercial trapping and fishing, peat extraction, timber harvest, wild rice harvest, and seasonal hay cropping. Many provincial and territorial governments in turn derive significant revenue from the harvest of wetland products. For example, in 1981, \$43 million was spent in British Columbia on hunting from marshes and \$38 million was spent in Alberta (Shay 1982).

### **Fur Harvest**

Commercial fur harvests in Alberta generate substantial provincial income. During 1973 and 1978, natives in the Peace-Athabasca delta earned more than \$1.6 million trapping muskrat (Smith 1986). Cowan (1982) estimated the potential wetland contribution to the fur industry in Alberta at \$22.3 million. This compares to a potential wetland contribution in Canada of \$120 million. Commercial fishing also generates substantial provincial income. More than 2,000 commercial fishing licences were sold

in Alberta in 1985-86. The 3.2 million kilograms of fish harvested generated \$2.8 million in provincial revenue (Alberta Fish and Wildlife 1987).

### **Peat Extraction**

Peat extraction is a growing industry in Alberta. Peat is used as a soil additive to enhance gardening and horticultural activities, and as a raw material for fuel and chemical production. In Europe, the medicinal properties of peat are valued for use in spas and for the preparation of medication. In 1986, the value of Alberta peat products was estimated at approximately \$10 million.

### **Forestry**

Northern wetlands have commercial value for timber production. The Canadian Forestry Service has estimated that approximately four million hectares of treed wetlands are suitable for forest growth enhancement in northern Alberta. Ditching and draining, which lowers the water table, can be used to improve aeration and subsequently increase tree growth rates. A federal research program is investigating the effects of drainage on tree growth and changes in ground cover at three experimental drainage sites in northern Alberta (Hillman 1987).

### **Wild Rice**

Wild rice harvest is also an expanding industry in Alberta. The 1989 Alberta wild rice harvest was in excess of 45,555 kilograms (100,000 pounds) and 110 individuals are now authorized as growers. Rice is grown in about 600 Alberta lakes.

The economic potential of the wild rice industry in Alberta remains to be determined. Canadian wild rice producers find it difficult to compete with American producers. Pricing is a significant obstacle to the development of wild rice as a commercial crop in Alberta. A grading system and improved marketing strategies could help to overcome this obstacle (Whyte Reynolds and Associates 1988; Alberta Rice Growers Association Annual Report 1988).

## Hay

Seasonal hay cropping of wetland margins has proven to be an effective means of producing highly nutritional forage for cattle. Small sectional dams can be erected to backflood wetland margins in the spring. This practice provides both productive waterfowl breeding and nesting habitat and ideal growing conditions for hay crops such as whitetop and slough sedges. Subsequent, controlled drawdowns (sections of the dam are removed to allow outflow and reduce water levels) in summer allow hay harvesting and provide slough hay for grazing cattle. Timed correctly, drawdowns and grazing do not adversely affect waterfowl because by summer the broods have moved from previously flooded wetland margins to larger, more secure wetland basins. Carefully engineered back-flooding and drawdowns have been employed successfully by Ducks Unlimited engineers and farmers throughout western Canada.

## Other Wetland Products

Reptiles, amphibians, fish, and invertebrates are collected and sold to biological suppliers for education and research. Plants and invertebrates are also gathered for food, medical supplies, aquaria, fish bait, and for use in the manufacture of chemicals. Arts and crafts industries benefit from the collection and sale of wicker and cane, the manufacture of home decorations from these products, and from sales of photographs and paintings inspired by wetlands.

## Consumptive Recreation

In 1983-84, Albertans spent \$867 million to hunt, fish, and view wildlife. The associated expenditures generated an estimated \$1 billion of economic activity and created 33,730 jobs to meet the demands for boats, motors, fishing tackle, transportation, accommodation, and guiding (Boxall 1986). The potential expenditure associated with recreational activities is enormous and many recreational activities are wetland related.

Adamowicz et al. (1986) determined the distribution of economic benefits from the Alberta duck population at \$18.4 million (in 1984 dollars). Of this amount, five percent of the benefits were realized by Alberta's rural population; nine percent by residents of Edmonton, Calgary, Red Deer, and Lethbridge; one percent by other Canadian residents; and 85 percent by United States residents hunting ducks that breed in Canada. Cowan (1982) estimated the potential wetland contribution of hunting in Alberta in 1982 at \$38 million and of sport fishing at \$98.5 million. This compares to a potential wetland contribution of hunting in Canada at \$172 million and of sport fishing at \$857 million.

## Social Benefits

### Education Benefits

Wetlands provide substantial research and educational opportunities. For example, a decade ago little was known about the environmental functions of wetlands in maintaining water quality and improving degraded waters, their potential for aquaculture, or the influence of wetlands on local weather and climate. Wetlands provide opportunities for public education about ecological processes and benchmarks against which to measure natural and human-induced change. Changes in wetland vegetation and invertebrate populations often indicate significant environmental changes such as climate warming and pesticide and contaminant loading. Wetlands also provide the potential for discovery of new uses for common and exotic species.

### Esthetics

Wetlands help fulfill societal needs for open space, variety, and landscape esthetics. They contribute to the richness and complexity of wilderness experiences, in turn promoting health and well-being. While the way in which wetlands promote health is partly related to the

opportunity for physical exercise, wetland areas contribute to a sense of well-being by providing the opportunity for people to escape from urban environments and the complexities of modern living. Wetland esthetic values are often enjoyed unconsciously: fulfilling individual needs for natural, rather than artificial stimuli, solitude, and providing creative and spiritual inspiration often derived from open space, landscape esthetics, and wildlife sightings.

### Option and Existence Values

Other social benefits of wetlands include option and existence values. Option values are based on the perceived benefits accruing to future generations through wetland preservation. Preservation allows for the option of making choices about how wetlands might best be used in the future. Existence values are derived from the knowledge that certain valued wetland benefits exist, regardless of any future choices about use.

### Nonconsumptive Recreation

Social, nonconsumptive benefits are realized by photographers, artists, and outdoor recreationists who use wetlands to photograph, paint, and view wildlife. Canadians are expressing an increasingly strong desire for wildlife viewing experiences as part of leisure and travel activities. Of the \$550 million spent on wildlife-related recreation in Alberta in 1981, 63 percent was spent on nonconsumptive trips and outings (Fillon et al. 1983). This same survey found that more than 22 percent of Albertans take overnight trips for the primary purpose of viewing wildlife. Approximately 30 percent of Albertans participated in consumptive wildlife activities such as hunting and fishing, while 86 percent pursued nonconsumptive wildlife-related activities (Fillon et al. 1983).

These kinds of activities translate into thousands of recreation days and millions of dollars in associated expenditures. The potential benefits of nonconsumptive, recreational wetlands activities for Alberta's tourism industry are considerable.

### Summary

It is important to understand the significance of wetlands in the larger scheme of things, as moderators of watershed hydrology, as valuable habitat for many animal and unique plant species, and for providing Albertans with a wide range of environmental, economic, and social benefits. Not all wetlands need to be preserved, but it is critical that equal consideration is given to both the benefits of wetland conservation and planned wetland development. Sustainable wetland use requires public understanding of the many functions and benefits provided by wetlands and the building of long-term public support for wetland management and protection.

## Interactions With Other Resource Sectors

**N**o one is suggesting that all wetlands be left in their natural state ... but it is essential to realize how important wetlands are in conserving and purifying the water that ...[humans] and wildlife depend on for survival (Michael Keating, *The Globe and Mail*).

One of the main objectives of the Alberta Conservation Strategy, of which this report is part, is to identify the interactions among the various resource sectors that contribute to the Alberta economy, in an effort to find mutually acceptable solutions to resource management issues. Almost all the resource sectors—agriculture, oil and gas, forestry, fish and wildlife, tourism, parks and outdoor recreation—examined by the conservation strategy process have an impact on wetlands. Many resource sectors benefit economically from wetland functions; yet, for other sectors, wetlands pose problems.

### Fish and Wildlife

Current land use management practices that result in the drainage of wetland basins and the alteration of wetland margins have led to severe declines in many wildlife species. Wetland habitat degradation and loss, for example, is responsible for the significant and continuing decrease of breeding populations of mallard, pintail, and blue-winged teal since the 1960s. Mallard duck numbers on the central flyway have declined from 1969 to 1984 at a rate of 19 percent per year (Environment Canada 1986). The Canadian Wildlife Service believes that without intensive conservation management on private and public lands the likelihood of these

populations recovering to former abundance is minimal (Environment Canada 1986).

Many agencies such as Alberta Fish and Wildlife, Ducks Unlimited (DU), and Wildlife Habitat Canada (WHC) have made substantial efforts to preserve wetlands. Cooperatively, these agencies have been most successful in maintaining and enhancing large, permanent wetlands. Unfortunately, permanent wetlands do not meet all the habitat needs of breeding and nesting waterfowl. Furthermore, migrating waterfowl are frequently concentrated on permanent wetlands in the autumn where they often cause or accentuate crop damage. Conservation efforts that focus on large permanent wetlands often succeed at the expense of smaller and equally valuable temporary and semipermanent wetlands.

Smaller temporary wetlands are particularly important to breeding waterfowl when they return in the spring. Spring migrants are dependent on high densities of small, ice-free, temporary ponds. These temporary ponds are shallow basins that hold runoff water from snowmelt. The shallow water heats rapidly and, as a result, teems with aquatic invertebrates, an essential source of protein for nesting hens.

Deeper semipermanent ponds are also important to breeding ducks. The perennial emergent and submergent vegetation, which characterizes these wetlands, provides food, water, and cover for duck broods. As water levels recede during the summer, semipermanent wetlands provide a ready source of aquatic invertebrates.

What is important to waterfowl and to the life cycle of most prairie wildlife forms are

wetland complexes that include temporary, semipermanent, and permanent wetlands and provide a range of habitats throughout the breeding season. It is the variety of wetlands found on the prairies that makes this habitat so productive for wildlife.

For Alberta to fulfill its obligation to the North American Waterfowl Management Plan (Environment Canada 1986), which has the maintenance of abundant waterfowl populations as one of its main objectives, it will have to address the problems posed by persistent loss of temporary and semipermanent wetlands.

Increasingly, wildlife agencies are beginning to devote effort to the preservation of wetland complexes. Successful continued wetland management for wildlife will depend on the inclusion of wetland conservation in land-use policies and programs. Further development of cooperative, multiagency approaches, including the meaningful involvement of nongovernment organizations is an effective means of securing and managing wetland habitat for wildlife.

## Agriculture

Wetlands provide many tangible benefits to agriculture:

- 1) contributing to moisture retention by trapping snow, storing runoff, recharging groundwater and potable water supplies;
- 2) moderating arid climates by providing surface water for evaporation, transpiration, and precipitation;
- 3) improving water quality through the absorption of agricultural wastes such as nitrogen, phosphorous, pesticides, and herbicides;
- 4) reducing the erosive effects of floods;
- 5) maintaining stable perennial plant communities (disturbed wetlands facilitate outbreaks of annual weeds); and
- 6) providing habitat for a variety of vertebrates and invertebrates that control weeds and agricultural pests, such as seed-eating birds and parasitic and predatory invertebrates.

Although wetlands provide a variety of agricultural benefits, there are many reasons why farmers drain them. By far, the most prevalent reason is to make field work easier. Numerous small potholes increase field time, decrease efficiency, and limit the size of equipment that can be successfully used. Morgan (1985), in a survey of landowner attitudes in the prairie pothole district of Manitoba, found that 97 percent of farmers drained wetlands to make field work easier, 21 percent drained them to increase cultivated acreage and decrease salinity, six percent wanted to reduce crop depredation by wildlife, and three percent wanted to decrease water levels.

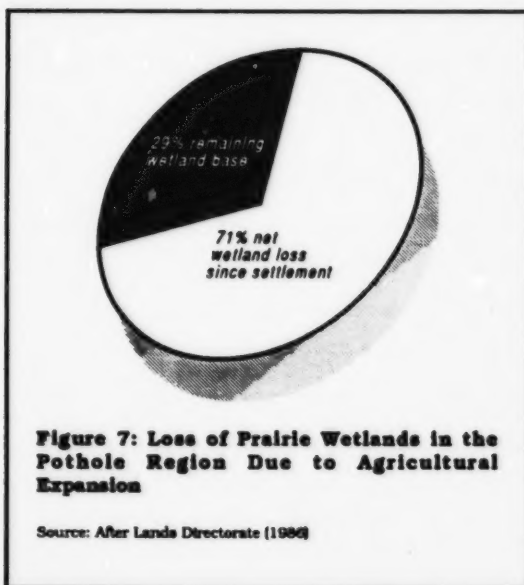
Dejardins (1983) has shown that the presence of obstacles such as those presented by wetlands are a real cost to landowners involved in modern intensive farming operations. The viability of farms that are only marginally profitable can actually be threatened by the increased operation costs associated with wetland retention. This belief was shared by most farmers surveyed by Morgan (1985). Morgan also noted that, although farmers were aware of the cumulative impact of wide-scale wetland conversion on waterfowl, most believed temporary and seasonal ponds were of little value to wildlife.

Conflicting government legislation and policies have contributed significantly to wetland drainage for agriculture conversion. Some government departments have been committed to soil and water conservation while others have provided funds for clearing and draining. In prairie Canada alone, there are some 20 Acts and policies dealing with water control (Brace and Pepper 1984). Many of these Acts and policies were designed in the belief that increased production was necessary and that drainage was a desirable way to facilitate this.

One of the most significant policies that has adversely affected prairie wetlands is the Canadian Wheat Board Act. This Act established a grain quota marketing system that regulates the amount of grain a farmer can sell, based on

the extent of land under cultivation. Wheat Board regulations stipulate that for land to qualify for delivery quota it cannot be in a native or wild state, but must have been improved by cultivation. As a result, lands with low agricultural capability, including wetlands, woodlots, and pasture, have been broken, often not to grow food crops, but to increase quota acreage.

Farmers surveyed in the prairie pothole district of Manitoba attributed the breaking of marginal land to meet Wheat Board quotas as the principal reason for widespread wetland drainage and clearing (Morgan 1985). They maintained that if it were possible to include unbroken marginal lands in their acreages under cultivation, fewer wetlands would be converted. The quota system is being re-evaluated to address the problem of encouraging the conversion of marginal lands to agricultural production.



The Canadian Income Tax Act also encourages agricultural use of marginal lands, including wetlands, through its taxation policies governing nonproductive land. There are no deductions for preserving native lands essential

to wildlife and of considerable public value. Provincial property taxes encourage the same. Rural lands are classified as either cultivated, pasture, or wasteland. Because tax notices do not reflect the rate of taxation for a variety of rural land classes there is meaningful incentive for landowners to make wasteland (i.e., wetlands) profitable.

From a farmer's perspective, wetland drainage is economically logical. Government money and expertise are provided to improve poor quality agricultural lands, such as wetlands, thus encouraging farmers to drain them. If the wetland base in the White Area of Alberta is to be maintained, it is important that wetland values are incorporated into water management programs for agriculture. Wetland use and management should be linked to other land-use and resource policies and programs. New approaches must be developed to ensure that wetlands become a significant component of a farmer's total land holding. Policy changes, ongoing soil and water conservation efforts, and more emphasis on public education are all needed to reduce the loss of prairie wetlands.

Some progress toward this end is taking place. For example, in Alberta, the new rural tax system, which will be fully implemented by the end of the 1990s, bases its assessments on soil capacity, tree cover, and subsequent anticipated agricultural net income. Lower tax rates will automatically apply to marginal lands because they characteristically support little, if any, agricultural income.

Recently, there have been a number of highly innovative joint federal, provincial, and private efforts to ensure greater soil and water conservation through programs that work with landowners to help retain wetland habitats. These efforts include those of the North American Waterfowl Management Plan, Prairie Farm Rehabilitation Administration's (PFRA) Permanent Cover Program, and World Wildlife Fund's Prairie for Tomorrow Program.

## Forestry

Forest ecosystems are a dynamic complex of wetland and upland habitats. Wetland complexes in forest ecosystems contribute significantly to nutrient recycling and provide habitat for many plants and animals. Muskeg, for example, provides significant habitat for a wide range of fauna including insects, fish, reptiles, birds, and mammals. During drought years on the prairies, when breeding waterfowl are displaced farther north, boreal forest wetlands are particularly important as refuge areas.

Although wetlands are seldom the exclusive habitat of wildlife, many species depend on wetlands at some stage of their life cycle. Woodland caribou, for example, prefer open lichen-rich black spruce stands in winter and during calving season; deer find shelter in dense black spruce swamps during snowstorms; and moose are regular inhabitants of lake margins, swamps, and fens.

Boreal forests are frequently subject to periodic wildfires, in spite of considerable efforts to control them. Most wetlands, however, are not susceptible and act as refuges for wildlife during fire. They also provide shelter and food for wildlife until burned areas are revegetated.

Boreal wetlands also have commercial value. As the forestry industry expands in Alberta, wetland drainage is being considered and tested as a means of increasing timber production. Through programs of ditching and draining, unmerchantable trees growing on peatland can attain commercial sizes within a few decades.

Such programs, however, affect the thermal properties of the upper peat layer of northern forest soil. A dry peat layer—the effect of draining—characteristically inhibits the transfer of heat into soil. Resulting lower soil temperatures at the surface can promote the formation of permafrost (Brown 1977), inhibit root penetration, and slow metabolic activity (Swanson and Rothwell 1986). Ironically, large-scale drainage that is designed to encourage

merchantable tree growth could actually retard forest growth.

Peat extraction is a growing industry in Alberta. Large-scale peat mining has the potential to destroy significant areas of northern wetlands. Careful recontouring and revegetation of exhausted peatland will be essential to offset the loss of valuable wildlife habitat.

The development of a comprehensive wetland management policy for Alberta that recognizes all wetland values and benefits is needed to guide forestry land-use decisions that affect northern wetlands and forests.

## Nonrenewable Resources

Nonrenewable resource activities can have significant negative impact on the quality of surface and subsurface water because these activities alter the hydrologic balances carefully maintained and regulated by natural wetlands. The degree of impact depends on the type of development, the terrain involved, and the duration of the disturbance.

The petroleum and gas industry, for example, accesses and uses local water supplies in many different ways. Almost all wells drilled in Alberta use water as a major fluid constituent. Water is used for gas processing and storage; it is also required for all primary, secondary, and tertiary recovery of oil and gas.

The general effects of the physical disturbance of wetlands and wetland margins through extractive activities include silt loading of streams, altered groundwater regimes, and disturbance or loss of fish and wildlife habitat. The following specific impacts are associated with nonrenewable resource extraction.

- 1) Seismic exploration can cause disruption of aquifers. Water can then escape to the surface from aquifers and deplete water supplies, or it can move between aquifers, which increases the opportunity for contaminated and uncontaminated waters to mix.
- 2) Improper crossing of coulees, ravines, or watercourses can degrade waterbodies by causing erosion and siltation.

- 3) Construction of plant sites, and the preparation of wells, pipelines, and roads can result in erosion, runoff, and degradation of water quality.
- 4) The leaching or runoff of herbicides used to control vegetation around well sites, plant sites, and pipeline rights-of-way can also cause the degradation of surface and groundwater supplies.
- 5) The spilling of drilling muds and saline or hydrocarbon formation fluids can impair wetland functions by altering their chemistry.
- 6) Sulphur dioxide from coal generating plants and the process of extracting sulphur from sour gas impairs wetland functions by increasing acidification. This change adversely affects wetland plants and animals that rely on specific wetland chemistry.

Substantial provincial legislation regulates water use in Alberta. Acts or regulations pertinent to the nonrenewable resource sector include the Ground Water Act and Regulations, the Department of the Environment Act, the Energy Resources Conservation Act, the Groundwater Development Act, the Hazardous Chemicals Act, the Land Surface Conservation and Reclamation Act, and the Pipeline Act. While all of these Acts are intended to keep environmental impacts associated with nonrenewable resource sectors to a minimum, the cumulative effects of surface water, groundwater, and sediments with particular contaminants (e.g., toxic organics, heavy metals, and certain inorganic ions) need to be addressed jointly.

### **Tourism, Parks, and Outdoor Recreation**

Wetlands are enjoyed for their physical attractiveness, natural history, and *wetness* in contrast to hotter, drier, upland areas. Wetlands constitute important amenity features of rural and urban landscapes and provide a variety of consumptive and nonconsumptive recreational and tourism opportunities.

As discussed in Chapter Two, the economic value of wetlands is substantial. The Long Point

and Point Pelee marshes in Ontario are probably the best known examples of the profitability of wetlands in Canada. Not only are these marshes priceless nature reserves, but they also generate \$5 million a year in tourism revenue. This income and its associated multiplier effects, such as the more than \$1 million spent on film each year have created increased economic activity and more local jobs. In Ontario, wetland-related tourist activities account for \$853 million in annual revenues. Another \$11 million annually is collected for licences and fees. Fillion et al. (1987) estimated that Canadians spend an astonishing \$5 billion annually on wildlife-related activities, many of which are wetland related.

In Alberta, individuals and groups who boat, canoe, fish, and view wildlife on wetlands make a significant contribution to the province's economy. Substantial funds are also spent by Albertans and non-Albertans who visit and use Alberta's provincial parks and natural areas, many of which are characterized by wetlands.

Increasing tourism, use of parks, and outdoor recreational pursuits will continue to place demands on wetlands for consumptive and nonconsumptive forms of recreation. Wetland habitats can, however, be altered or ultimately destroyed by excessive levels of recreational use. Controls are necessary to ensure that wetland functions are not impaired by erosion, sedimentation, and loss of wetland vegetation. It is important to promote the development of a wetland ethic by ensuring that substantial information on wetland values is available to schools and the general public. Management plans need to be developed for important recreational wetlands that allow for use, while conserving renewable wetland values.

### **Urban Environment**

Wetlands provide many benefits—water supplies, flood control features, sewage treatment, and pollution control measures—to Alberta's urban dwellers. Most of these benefits are enjoyed at minimal cost. A few cities in Canada, the United

States, and Mexico are already taking further advantage of the cost-effectiveness of wetland functions. These urban centres are now filtering their sewage through natural or artificial wetlands. These marshes are not only managed for pollution control; they also serve as wildlife habitat, and as public recreation areas.

Wetlands retained within the urban environment or found on its periphery provide ideal public recreation opportunities for fishermen, canoeists, birdwatchers, hikers, naturalists, and photographers. Educational benefits are also derived from wetlands as recreationists are exposed to rich sources of information about natural processes.

Although urban wetlands are often viewed as nuisance areas providing breeding grounds for insect pests, the development of a wetland ethic among the general public will help to ensure conservation of urban wetlands. Public interest groups could be encouraged to play a meaningful role in securing and managing urban wetlands. Enabling legislation and/or policy to facilitate fundraising by these groups would also help to encourage and secure urban wetlands.

## Assessing Wetland Benefits

**W**e have to decide whether these places [wetlands] are public interest lands or just real estate (Arlin Hackman, Federation of Ontario Naturalists).

Clearly, a demand exists for the many products and services that wetlands provide. Alberta's fish and wildlife, tourism, and parks and recreation sectors, which make significant contributions to Alberta's economy, depend heavily on wetland benefits such as habitat retention and productivity. Similarly, the environmental benefits of wetlands are essential to the longterm viability of Alberta's agriculture and forest industries. The water supply function of wetlands is also important to the extraction of nonrenewable resources such as oil and gas. And most significantly, the health and well-being of Albertans is linked to the environmental, economic, and social benefits provided by wetlands.

Although knowledge about wetland characteristics, their functions and benefits are increasingly known, wetlands are still being converted to other uses. This is largely because most wetland benefits are not fully or adequately priced in the marketplace. Even when certain wetland uses are recognized and priced, hunting licences for example, frequently the price does not reflect the full value or worth of the product. The value above and beyond that provided for in the marketplace is called the *consumer surplus*.

Because wetland benefits are to a large extent unpriced, traditional economic assessment procedures are difficult to apply. As a result, usual analyses of the costs of wetland conversion to other uses (agricultural

production/urban development) fail to demonstrate or underrecognize the value of conservation. Even when prices exist, they often do not reflect wetland benefits because of the existence of large consumer surpluses (Bardecki 1988).

A further difficulty in valuing and conserving wetlands is the common property aspect of many wetland benefits. Frequently, these benefits are realized beyond the normal bounds of property ownership. For example, although a local landowner may benefit from wetland retention, most of the benefit such as maintenance of water supply and water quality are realized elsewhere; for example, on a watershed. As a result, wetland conversion from a natural state usually involves the loss of public benefits. All too often the costs of conversion to an alternative use are borne by the public as are the costs associated with the loss of wetland function.

The wide dispersal of wetland benefits makes perception of the resource's value more difficult still. Wetland benefits are generally diffuse and most often realized, in the aggregate, over time. Because wetland benefits are diffuse and not widely perceived, decisions are often made by local authorities without knowledge of regional and provincial implications.

The important first step toward wetland conservation, as discussed in Chapter Two, is public awareness of wetland benefits. The second critical step is the development and use of methods that can help identify and measure the environmental, economic, and social benefits of wetlands, which for the most part are underpriced in the marketplace. Such tools will help to remove the second obstacle to achieving

sustainable wetland use in Alberta—the lack of quantitative data on the value of wetlands.

### Wetland Valuation Approaches

Efforts are being made by a number of agencies and organizations to arrive at some means of assigning value to wetland functions and benefits. These approaches to evaluating wetlands deserve considerable merit, given the challenge that wetlands pose for analysts. Further progress will require a means of deriving quantitative and qualitative measures that can be used as appropriate indicators of wetland value (Bardecki et al. 1988).

During the last decade, a number of approaches have been developed. Jaworski and Raphael (1978) calculated the gross annual income per hectare of wetlands in the Great Lakes region, by estimating incomes generated from sport fishing, nonconsumptive recreation, waterfowl hunting, furbearer trapping, and commercial fishing. They found that wetlands generated a gross return of \$1,160 per hectare per year. Gosselink et al. (1974) used an income-capitalized value technique to determine the present value of a tidal marsh in Louisiana by estimating the value of the marsh's fisheries, aquaculture, storm buffer, and tertiary waste treatment benefits. These benefits generated a total net annual income of \$10,250 per hectare.

Tilton et al. (1978) used an ecosystem replacement value to determine the 30-year cost of replacing various wetland functions. They estimated the cost of replacing the nutrient removal functions of a wetland in 1980 dollars to be \$84,000 per hectare. Farber and Costanza (1987) used an economic willingness-to-pay (WTP) approach to assess the value of a Louisiana coastal wetland system for commercial fishing, trapping, recreational uses, and storm protection. By estimating the amount that survey subjects were willing to pay for specific wetland benefits, this approach established a more or less hypothetical value for those wetland benefits that did not have a market price.

Farber and Costanza also used an energy

analysis (EA) approach to estimate the total amount of energy captured by the wetland as a means of measuring its potential to do useful work for society. Their estimates of worth ranged from \$590 per hectare, using the WTP approach, to \$6,400-\$10,000 per hectare using the EA methodology. Farber and Costanza concluded that the WTP estimate was low because it excluded several known wetland benefits and that the EA estimate was likely too high.

### Integrated Approach

A recent joint effort by the Canadian Wildlife Service (CWS) and Wildlife Habitat Canada (WHC) (1988), including cooperation with the Sustainable Development Branch of Environment Canada, has investigated improved methods of wetland evaluation. The study involved methodology development, pilot field testing, and will eventually result in the development of a manual for use by local and provincial planners in evaluating development proposals that have an impact on wetlands.

This study was initiated on the premise that common evaluation procedures such as cost-benefit analyses, are for the most part insensitive to the broader environmental values and long-term societal benefits of wetlands and therefore, inappropriate to measuring wetland values (Bardecki et al. 1988). Three alternative wetland evaluation methods were applied and evaluated: willingness-to-pay for wetland values, an opportunity cost approach, and a cumulative impact approach. These were tested across the country.

**Willingness-to-Pay** — The willingness-to-pay approach involved establishing a more or less hypothetical market by estimating people's maximum willingness to pay for those benefits. Application of the willingness-to-pay approach most often relies on the use of a questionnaire to determine estimates of personal valuation for wetland functions and benefits. Theoretically, this approach had the benefit of demonstrating not only economic interest, but political willingness to pay for benefits.

The fundamental difficulty with the willingness-to-pay method, however, was the lack of public knowledge about wetland functions and benefits. Unfortunately, wetland benefits are not traditional market goods. It is therefore more difficult for consumers to compare the relative value of wetland benefits than it is to make a choice between, for example, having a new colour television set or spending a weekend in San Francisco. Lack of public knowledge makes use of a valuation procedure that relies on an informed public less suitable than other methods.

**Opportunity Costs** — The opportunity cost of conserving a wetland is the net benefit lost by a potential developer wanting to convert a wetland to another use. If, for example, there is no cost increase in using a nearby nonwetland site as a suitable location for a shopping centre, then the opportunity cost associated with the proposed development is zero. Nothing need be foregone to preserve the wetland. Similarly, if a wetland is converted to another use the opportunity costs associated with the conversion are the costs of the lost wetland values. The principal difficulty with this approach is that while other domestic or industrial opportunity costs are easy to equate with dollar values, wetland opportunity costs are not. The lack of consensus on the nature of wetland functions, lack of adequate research on the benefits derived from wetland functions, and the extra-market nature of wetland benefits preclude such measurement.

**Cumulative Impact** — The cumulative impact approach was used to evaluate development proposals that promised to directly affect wetlands. This approach compares anticipated development benefits against a list of socially valued wetland benefits.

To apply this approach, the joint study reviewed existing provincial and federal legislation and policy pertaining to wetlands, and used it to identify quantitative benefits (for example, recognized measurable water quality standards) and qualitative wetland benefits (for example, conservation of habitat diversity).

These benefits were then compared to the advantages of development and used to identify the wetland functions expected to be impaired or lost if development were to proceed.

The advantage of the cumulative impacts approach is that several criteria are used to evaluate a development proposal. By identifying the wetland benefits to be affected, this approach achieves a very detailed accounting of the cost of any action pertaining to wetlands. The success of this method is largely dependent, however, on the establishment and adoption of clearly defined objectives and standards for key wetland functions and benefits, and the catalogue of these defined objectives and standards is sadly incomplete. The cumulative impact method is promising, however, because it is one of few that attempt to incorporate the range of functions and benefits provided by wetlands.

### Component Approach

The Wildlife Branch of the Ontario Ministry of Natural Resources (OMNR) and Ontario Branch of the Canadian Wildlife Service (CWS) have developed a wetland evaluation system that rates wetlands with regard to their relative benefits (Ministry of Natural Resources and Environment Canada 1984). The scheme quantifies (measures) wetland values in a manner that permits comparison of wetlands. This comparison enables negotiators to examine conflicting claims about wetland values and resolve them so that knowledgeable land-use decisions can be made. The joint scheme, which provides a balanced way of measuring important wetland values, was developed and field tested over a four-year period.

The Ontario CWS method identifies four principal categories of wetland benefits—biological, social, hydrological, and special features—for evaluation. Within each category are criteria for rating the level of benefit a specific wetland delivers in each category.

**Biological Component** — According to the Ontario CWS system, the biological component of a wetland is evaluated on the basis of

productivity, diversity, and size, as well as a number of interrelated values. Productivity offers a useful measure of value because it provides an indication of the ability of an area to produce a crop of living organisms. Diversity is an effective indicator of value because wetlands that incorporate diverse aquatic and terrestrial habitats attract more animal species than wetlands with uniform environments. Size is used as a measure of value because a large wetland will likely deliver a number of valuable benefits.

**Social Component** — To assess the value of social wetland benefits, the Ontario system identifies seven categories for evaluation: resource products with cash values, recreation activities, esthetics, education and public awareness, proximity to urban areas, ownership and accessibility, and size. Economic benefits are included under this category because the economic contributions are considered to have social value. Occurrence of resource products is used as part of the measure of what would be lost if a wetland were converted to other uses.

The Ontario CWS system uses a rating scheme to assess the intensity of wetland-recreational interactions such as hunting, nature appreciation, canoeing, and boating. Wetland esthetics are measured according to landscape distinctness and the absence of human disturbances. Value is also assigned to wetlands that are used for educational and research purposes. Proximity to urban centres is used as a criterion for evaluation because wetlands that occur near urban centres are usually visited more often than wetlands in wilderness settings. Ownership and accessibility are assessed because more people usually benefit from a wetland when it is controlled by some form of public ownership and when accessibility is high. Wetland size is used as a criterion because it is often important to determining overall social values.

**Hydrological Component** — The hydrological component of wetlands is evaluated according to flow stabilization, water quality improvement,

and erosion control criteria. Flow stabilization is used as a means of evaluating detention of surface flow during storms, augmentation of flow during dry periods, and erosion control (see Chapter Two). Wetland vegetation is evaluated because it is an important factor in minimizing erosion. The water quality improvement function of wetlands is evaluated according to the ability of a wetland to remove nutrients from surface waters and to act as a net receiver of nutrients.

**Special Features Component** — Three measures: rarity and/or scarcity, significant features and/or fish and wildlife habitat, and ecological age, are identified as important criteria in assessing the special features of a wetland. Scarce wetland types and scarce wetland plant and animal species are evaluated by the degree of rarity; locally, regionally, and provincially. Significant habitat features were included if they had exceptional importance in the public mind. The Ontario CWS approach uses the ecological age of a wetland as an important indicator of habitat status because the older the wetland, the longer it takes to restore it to its present condition if destroyed. This measure assumes that the desirability of preserving a wetland can be measured in part by the amount of time and cost involved in replacing it.

### Ecological Framework

An ecological framework for evaluating wetland functions and benefits has the advantage of organizing the province's considerable wetland information into naturally occurring biophysical units. This approach provides a framework for evaluating both relative wetland functions and benefits with consideration for the significant differences of climate, landform, and relief that occur in Alberta.

The National Wetlands Working Group (1986) recognizes seven wetland regions in Alberta. These are areas that share similar and characteristic wetland development in locations with similar topography, hydrology, and nutrient regimes. A wetland regions assessment of

wetland functions and benefits provides an ideal framework for incorporating region-specific biological, hydrological, and social wetland differences.

An equally useful approach would be to organize wetland information by river basin and/or by watershed. Both are naturally occurring ecological units and both have advantages as suitable management areas. Wetland management by river basin, for example, is well suited to regional water management, whereas wetland management by watershed lends itself to the sharing of water and soil management responsibilities among local jurisdictions.

A hierarchical scheme that organizes wetland information by watershed, grouping this information by river basin and subsequently by wetland region, could potentially satisfy the needs of local, regional, and provincial agencies, many of whom share responsibilities for water management.

### Discussion

The solution to the problem of wetland valuation requires the use of methods that have the ability to address the fundamental nature of the problem. Unfortunately, wetland benefits are consistently undervalued because they are widely dispersed and difficult to quantify. Many good wetlands have, therefore, been converted to other uses or altered simply because their value to society could not be adequately demonstrated.

The problem of evaluation is further complicated because traditional methods of evaluation, such as cost-benefit analyses, are generally inappropriate. These methods are insensitive to broad environmental values and long-term societal benefits, favouring instead short-term and more easily valued uses of the land resource.

The integrated approach employed by the Canadian Wildlife Service and Wildlife Habitat Canada has considerable merit in assessing wetland value because it embraces a number of techniques; willingness to pay, opportunity

costs, and cumulative impacts in assessing wetland value. Of the three techniques used, the cumulative impacts approach is probably the most effective because it attempts to incorporate the range of wetland function and benefits when evaluating the impact of development proposals.

The component approach used by the Ontario Ministry of Natural Resources is useful for assessing the relative numerical importance of wetlands. This approach in combination with the cumulative impact technique provides a number of quantitative and qualitative measures useful for describing and assessing wetland value.

No one approach, however, is able to supply all the answers. As a consequence, political decision makers will have to be prepared to assess and weigh public concerns and exercise leadership on behalf of the public interest.

### Conclusions

Assuming that the various sectors of Alberta's economy expand and the population grows, demands for the services wetlands provide will continue to increase. Loss of wetland functions will be keenly felt by future generations. Though the costs may be hidden, Albertans are already paying for flood protection and water purification—substitutes for natural wetland functions.

In future, Albertans will have to pay more for these services, face supply and service shortages, and have to forgo rewarding, relatively inexpensive satisfaction such as wilderness experience opportunities, that can be gained from wetland benefits. The challenge will be to overcome the common tragedy wherein long-term economic benefits are sacrificed for short-term economic gains.

## Legislative Regimes

There are more than 10 provincial and federal government departments and numerous private organizations and groups whose decisions have some effect on wetlands. This chapter reviews the federal and provincial legislative regimes currently affecting wetlands in Alberta, including: legislation that directly affects wetlands; legislation that affects wetlands indirectly and unintentionally; and policies that have habitat preservation as a stated objective. The intent of this survey is to demonstrate that the absence of a comprehensive legislative system pertaining to Alberta wetlands is a significant, third obstacle to achieving sustainable wetland use.

While an indepth analysis of the constitutional division of legislative powers in relation to wetlands would be a necessary part of detailed proposals for change, such analysis is outside the scope of this review. This report also does not purport to quantify the effects of competing legislation with any precision. To do so would require systematic interviews with government personnel administering the legislation and landowners who are subject to it. Such studies have been conducted in this context in other provinces (Morgan 1985; Zittlau 1979). The time and logistics of this report did not permit extensive interviews of this kind.

### Federal Legislation

#### Direct Legislation

**Migratory Birds Convention Act** — The Migratory Birds Convention Act (Revised Statute of Canada [R.S.C.] 1970, chapter [c.] M-12)

ratifies the International Convention for the Protection of Migratory Birds of 1916. The convention was established between the United States and Great Britain, on Canada's behalf, to ensure migratory bird conservation. The importance of the convention lies in the foundation it provides for the North American Waterfowl Management Plan, which is an agreement between Canada and the United States that was signed in May 1986. The general objective of this plan is for the two countries to cooperate in achieving waterfowl population goals. The importance of the plan from a wetland

| Federal                                                                                                    |                                                                                                                                |
|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Legislation and Policies with Direct Effects                                                               | Legislation and Policies with Indirect Effects                                                                                 |
| Migratory Bird Convention Act<br>Canada Wildlife Act<br>Federal Water Policy<br>Federal Policy on Land Use | Income Tax Act<br>Prairie Farm Rehabilitation Act<br>Agricultural Marketing Legislation<br>Agricultural Assistance Legislation |

habitat perspective lies in one of its stated principles:

The maintenance of abundant waterfowl populations is dependent on protection, restoration, and management of habitat. The persistent loss of important waterfowl habitat should be reversed.

The plan provides for funding from both public and private sources toward this objective. **Canada Wildlife Act** — The Canada Wildlife Act (Statute of Canada [S.C.] 1973-74, c.21) gives broad powers to the federal minister of the environment. The relevant powers include authority to:

1. coordinate and implement wildlife policies and programs in cooperation with the government of the province having an interest therein (section 3, subsection (e));
2. undertake the management and control of lands required for wildlife research, conservation, or interpretation upon being assigned such lands by the governor-in-council including power to carry out measures for the conservation of wildlife on such assigned lands (section 4, subsection (2)(c));
3. enter into agreements with the provinces to provide for wildlife research, conservation, and interpretation programs (section 5, subsection (a));
4. enter into agreements with any municipal authority or other organization or with any person for the purposes noted above (section 7, subsection (l)); and
5. acquire, on the authorization of the governor-in-council, lands or interests therein for the purposes of research, conservation, and interpretation in respect of migratory birds or (with the agreement of the provincial government) other wildlife—these agreements are subject to section 6 which specifies their content.

It is noteworthy that section 2, subsection (2) of the Act states that "all the provisions of this Act respecting wildlife extend to wildlife habitat."

Wildlife Habitat Canada, a federally chartered nonprofit foundation that distributes federal funds for habitat preservation and development, is one example of a program constituted by the Canada Wildlife Act to deal with habitat. Federal National Wildlife Areas, Migratory Bird Sanctuaries, and Wildlife Interpretation Centres are also partially founded on this legislative authority. Some of these powers will be used in implementing the North American Waterfowl Management Plan.

**Federal Water Policy** — Released in December 1987, the Federal Water Policy sets out five broad strategies to promote water quality enhancement and efficient water management. These strategies relate to water pricing, scientific research, integrated planning, legislation, and public awareness. The policy also sets 25 specific policy objectives to be addressed by these strategies, one of which deals with wetlands:

The federal policy is to conserve and enhance Canada's wetlands through short- and long-term actions coordinated with other governments, private organizations, landowners, and the public. Accordingly, the federal government will contribute to this effort by:

- i. reviewing and seeking to minimize the negative impact of federal policies, programs, and activities on wetlands;
- ii. identifying, conserving, and managing wetlands of importance on federally owned or regulated lands;
- iii. cooperating with other governments in conserving and managing wetlands that serve important hydrological roles associated with improving water quality, sustaining water quantity, and moderating flood events;

- iv. encouraging appropriate land-use practices, integrated land and water resource planning, and application of environmental assessment processes and practices to mitigate undesirable effects on existing wetlands;
- v. conducting and promoting research to provide scientific and technological support for and understanding of wetland functions and values;
- vi. pursuing cooperative international and federal-provincial habitat protection, research, and management programs for fish and waterfowl, as agreed under treaties, conventions, and other bilateral agreements; and
- vii. promoting public awareness of wetland values and public participation in the conservation of wetlands.

**Federal Policy on Land Use** — Federal policy on land use is intended to guide federal policies and programs as they affect land use and to guide the management of federal lands, including federal lands within the provinces and the territories. The policy's stated goal is the "wise use of Canada's land resources." To further this goal, the Federal Policy on Land Use sets out six guiding principles, 11 policy statements, and 10 land-use guidelines. Two of the guidelines relate directly to wetlands; they aim to conserve both watershed recharge and storage areas, and critical habitat areas.

**World Conservation Strategy** — As of October 1981, the federal minister of environment endorsed the World Conservation Strategy on behalf of the Government of Canada. Parts of this strategy relate to wetlands (section 1, subsection 1).

**Federal Crown Land** — Although not based on legislation, *per se*, it should be noted that as owner of the federal lands in Alberta the federal

Crown can directly affect wetlands in those areas. These lands, however, represent a relatively small portion of the province's area.

### Indirect Federal Legislation

It has been pointed out by previous authors (Rakowski and Jurick 1986; Weiss 1982) that wetlands are subject to unintentional effects generated by federal legislation and policies which, on the surface, do not appear to be related to wetlands. Several of these are reviewed below.

**Income Tax Act** — The Income Tax Act (R.S.C. 1970, c. I-4) has been identified as a principal incentive for wetland drainage, because of the provision it makes for income tax deductions for expenses incurred while draining wetland habitat.

**Prairie Farm Rehabilitation Act** — The Prairie Farm Rehabilitation Act (R.S.C. 1970, c. P-17) was passed during the "Dirty 30s" and established the Prairie Farm Rehabilitation Administration (PFRA). The purpose of the PFRA is to rehabilitate areas damaged by drifting soils and promote systems of farm practice, tree culture, water supply, and land settlement to afford greater economic security for farmers. The Soil and Water Conservation Branch of the PFRA administers soil and water conservation programs that could have a substantial effect on wetlands in Alberta.

**Agricultural Marketing Legislation** — A number of federal Acts can have an indirect effect on wetlands by influencing agricultural markets; these were surveyed by Rakowski and Jurick (1986) and Weiss (1982). The Canadian Wheat Board Act (R.S.C. 1970, c. C-12) has had the most significant impact on agricultural markets. It established a grain quota marketing system based on a quota acreage assigned to each producing farmer. The quota acreage system creates an incentive for landowners to expand their grain quota by draining nonproductive areas (frequently wetlands) and cultivating them so that more land is eligible for inclusion in quota acreages.

**Agricultural Assistance Legislation** — Several federal Acts provide financial assistance to farmers in the form of grants, subsidies, and loans. Some of this financial assistance can be used to drain wetlands or clear upland nesting cover, thereby indirectly affecting sustainable wetland use. Grain transportation subsidies, which can encourage grain production over livestock production, can also affect land use and wetlands. Subsidy programs that are based on cultivated acreage represent further examples of legislation that can encourage landowners to increase cultivation at the expense of wetland areas. Many of the Acts in this general category are included in surveys conducted by Rakowski and Jurick (1986) and Weiss (1982).

## Provincial Legislation

### Direct Legislation

**Water Resources Act** — The general purpose of the Water Resources Act (R.S.A. 1980, c. W-5), which applies to water both on and under the surface of the ground, is to provide a licensing system for the diversion and use of water. As such, the Act purports to modify the water rights accorded by common law to owners whose land contains a watercourse.

The Act affects wetlands in several ways. First, it provides the authority for the granting of licences (section 11, subsection 1(b)(c)):

to impound water or use water in its natural state for the purpose of water management, flood control, erosion control, flow regulation, conservation, recreation, or the propagation of fish and wildlife or for any like purpose.

These *natural state* water licences have been used on occasion to preserve wetland areas in their natural state.

The second way the Act affects wetlands is by licensing wetland drainage. Section 5 of the Act prohibits unauthorized diversions and Section 11 provides a licensing scheme. Alberta

| Provincial                                                                                                                                                                                                                                                                                                                               |                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Legislation and Policies with Direct Effects                                                                                                                                                                                                                                                                                             | Legislation and Policies with Indirect Effects                                                                     |
| <p>Water Resources Act</p> <p>Water Resources Commission Act</p> <p>Drainage Districts Act</p> <p>Irrigation Act</p> <p>Wilderness Areas, Ecological Reserves, and Natural Areas Act</p> <p>Department of the Environment Act</p> <p>Planning Legislation</p> <p>Department of Forestry, Lands, and Wildlife Act</p> <p>Wildlife Act</p> | <p>Municipal Taxation Act</p> <p>Agricultural Marketing Legislation</p> <p>Agricultural Assistance Legislation</p> |

Environment, which administers the Act, has a policy of circulating wetland drainage applications to allow input from the Fish and Wildlife Division of Alberta Forestry, Lands, and Wildlife. Although there is no statutory duty to consider the input, this practice allows for some consideration of wildlife concerns in the licensing process.

The jurisdiction of the Water Resources Act in relation to a certain class of wetlands is somewhat uncertain. This uncertainty arises in relation to the distinction between wetlands overlying areas of public as opposed to private land. This distinction is drawn by section 3, subsection (1) of the Public Lands Act (R.S.A. 1980, c. P-30), which states that the beds and shores of permanent waterbodies are public land. Partly as a result of a judicial interpretation of section 3, subsection (1)'s predecessor in R.V. Very (1983), 149 D.L.R. (3d) 688 (Alta. Q.B.), this section is interpreted to mean that only those wetland areas that have

never been dry in recorded history are considered to be public land. The more temporary wetlands are considered to be private. This public/private distinction is important because there appears to be some administrative uncertainty with respect to the Act's application to wetlands overlying private land, despite section 2, subsection (1)'s (of the Water Resources Act) vesting of the property in the Crown and giving the Crown the right to divert all water in Alberta. As a result of this uncertainty, there may be some reluctance to prohibit or place conditions on drainage of important wetland areas.

The third avenue by which the Water Resources Act may affect wetlands is in its provision for the construction of works and undertakings (including drainage projects) by the minister of environment (section 83), alone or jointly with local authorities (section 90). Since section 95 provides that the Crown is bound by the Act, these projects must go through the licensing process described above. The primary effect of these two provisions is to create a method by which major drainage projects may receive public funds.

Finally, section 64 of the Act provides a potential means by which the minister of environment may bypass the licensing process in approving drainage works. This notwithstanding provision was at one time used to approve major drainage projects, but is apparently no longer used for this purpose.

**Water Resources Commission Act** — The Water Resources Commission Act (R.S.A. 1980, c. W-5.1) created the Alberta Water Resources Commission and gave an advisory mandate in relation to the water resources of Alberta. The Water Resources Commission is developing a multidepartmental inventory of wetlands, and a policy relating to wetlands that could have significant effects on future government policies and programs relating to wetlands. The commission reports directly to the Cabinet Committee for Economic Planning and Resource Development.

**Drainage Districts Act** — The Drainage Districts Act (R.S.A. 1980, c. D-39) provides for the creation of drainage boards that regulate drainage within the boundaries of their respective drainage districts. This places the administration of the water licensing scheme (described in section 6, subsection 3(1)(a)) in the hands of these boards. Nine of these districts (covering about 77,000 hectares) exist in Alberta, with the last formed in the 1950s. A Drainage Council, empowered by the Act, oversees these districts. While the impact of board decisions are, at present, primarily local, this vehicle for effecting drainage has potential importance for wetlands.

**Irrigation Act** — The Irrigation Act (R.S.A. 1980, c. I-11) provides for the creation of irrigation districts and their governing boards, which regulate drainage relating directly to the irrigation network (other drainage activities are subject to the licensing scheme under the Water Resources Act, described in section 6, subsection 3(1)(a)). The activities of these boards may have both positive and negative effects on wetlands. Several wetlands and wetland projects have benefited from water supplied by irrigation systems; yet rehabilitation work conducted on irrigation systems and intended to increase the efficiency of water use, has resulted in damage to adjoining uplands and wetlands. There are currently 13 irrigation districts with authority for over 600,000 hectares of irrigable farmland in Alberta. These districts are overseen by an Irrigation Secretariat and Council which, in addition to an ongoing construction and research program, is administering a \$30-million five-year rehabilitation program.

**Wilderness Areas, Ecological Reserves, and Natural Areas Act** — The Wilderness, Ecological Reserve, and Natural Areas Act (R.S.A. 1980, c. W-8) gives the provincial cabinet the power to designate certain public lands as "wilderness areas, ecological reserves, and natural areas" by regulation. Such designation provides varying degrees of protection from development. It has been used to protect wetlands such as Wagner

Bog, Beaverhill Lake, and the Outpost Wetlands natural areas.

**Department of the Environment Act** — One of the provisions in the Department of the Environment Act (R.S.A. 1980, c. D-19) provides the provincial cabinet with the power to designate "restricted development areas" or "water conservation areas" for a number of enumerated purposes, several of which include wetland conservation (section 16). The provisions of the Act appear to have received little attention or use in a wetland context.

The Act gives the Department of the Environment the authority for involvement in the cost sharing and development of a large variety of water management projects relating to, among other things, flood control and drainage; flow regulation, erosion control, and water supply; recreation, fish, waterfowl, and wildlife enhancement (Alberta Environment 1980).

**Planning Legislation** — The Planning Act (R.S.A. 1980, c. P-9) allows the provincial cabinet to establish "special planning areas" in which areas of public importance are controlled. The Planning Act has the potential to designate protected areas within municipal jurisdictions. However, the practice of municipal governments designating protected wetland areas is not widespread. Conversely, municipalities may pass bylaws for effecting and funding drainage (Municipal Government Act, R.S.A. 1980, c. M-26, subsection 188, 256). The Planning Act (section 98) also gives municipal bodies, which have subdivision approval authority, the power to create environmental reserves to protect wetland areas that fall within proposed subdivision areas.

**Department of Forestry, Lands, and Wildlife Act** — The Department of Forestry, Lands, and Wildlife Act (R.S.A. 1980, c. D-20.5) provides the minister of Forestry, Lands, and Wildlife the power to enter into agreements on or in connection with any policy, program, service, or matter under his administration (section 5(1)). In a wetlands context, this provision gives the minister power to place conditions on the use of

Crown wetland areas at the time they are sold to private landowners. In addition, "ecological corridor agreements" provide limited protection from development. These agreements require permission from Public Lands Division of Forestry, Lands, and Wildlife before development of subject areas.

The department created by this Act also has powers to enter into agreements and develop programs in relation to wildlife. Two of these programs relating to wetlands are the Waterfowl Habitat Program, aimed at managing key wetland areas in cooperation with Ducks Unlimited Canada, and the Buck for Wildlife Program, which also develops and manages habitat areas, including wetlands. This Act also allows the province to participate in the North American Waterfowl Management Program.

**Wildlife Act** — The Wildlife Act (R.S.A. 1980, c. W-9.1.) provides the authority to establish and control the use of wildlife sanctuaries and habitat development areas by regulation (section 96, 97). No hunting or trapping is allowed in wildlife sanctuaries without specific approval. There are eight of these designated sanctuaries in Alberta.

The Act's prohibition of paid hunting (section 49) has an indirect effect on wetlands. It prevents the development of a private market for wetland hunting rights and the concomitant incentives for habitat retention that could accrue to landowners. Whether such a market would develop in the absence of this prohibition is not clear.

**Water Resource Management Principles for Alberta** — This document provides guidelines for the provincial government's approach to water resource management and contains 20 principles. While no specific reference is made to wetlands, relevant principles in this context include those pertaining to water conservation, preferential and multipurpose water use, environmental impact assessment, and cost sharing.

**Provincial Crown Land** — Distinct from its powers as legislator, the provincial Crown enjoys

full rights of ownership as the proprietor of provincial Crown land, which constitutes over half the province's total area. Wetlands within these provincial Crown lands can be directly affected by the exercise of Crown rights. These rights of ownership are manifest in such statutes as the Public Lands Act (R.S.A. 1980, c. P-30) and the Special Areas Act (R.S.A. 1980, c. S-20), which delegate broad powers to various government departments. The Public Lands Act is also important in this specific context, as are the Wilderness Areas and Ecological Reserves and Natural Areas Acts, for asserting provincial ownership over the beds and shores of certain waterbodies and watercourses.

**Common Law Conservation Easements and Restrictive Covenants** — Although not legislative, per se, common law easements and restrictive covenants deserve mention here because of their use and potential use as instruments for preservation of wetland and associated upland areas.

To create legally enforceable restrictions on the use of land, common law easements and restrictive covenants must meet certain requirements that have been developed over many years by the courts. Due in part to their historical purposes, one of these requirements is that the easement or restrictive covenant must benefit neighbouring land owned by the grantee of the instrument.

This requirement creates some uncertainty as to the enforceability of easements or restrictive covenants when the grantee (e.g., a conservation group or agency) does not hold land appurtenant to the land subject to the grant. There is, in other words, some doubt as to whether these instruments run with the land so as to bind the grantor's successors in title.

One solution to this uncertainty may lie in amendments to the Land Titles Act (R.S.A. 1980, c. L-5), which deals with the registration and enforceability of such encumbrances. In fact, a precedent for such an amendment already exists in relation to pipeline and similar easements.

## Indirect Legislation

**Municipal Taxation Act** — Previous authors have suggested that the Municipal Taxation Act (R.S.A. 1980, c. M-31) and the resulting municipal assessments of wetlands on local tax rolls creates an incentive for wetland drainage (Rakowski 1986; Weiss 1982). These concerns also apply to the effects of related municipal taxation legislation. Such incentives for drainage have been recognized in several of the United States wherein wetlands are assessed at low or negligible rates or as tax credits. Alberta is now attempting to remove this incentive by implementing a net income approach to rural land assessment to be effected by the end of the 1990s.

**Agricultural Marketing Legislation** — Several provincial Acts influence the marketing of agricultural products (see Rakowski et al. 1986), thus creating an indirect effect on wetland areas on agricultural lands.

**Agricultural Assistance Legislation** — As with their federal counterparts, the numerous Acts providing financial assistance to agricultural operations have an indirect effect in implementing land-use decisions through a variety of financial incentives. Rakowski (1986) has summarized some of the programs developed under this legislation.

## Conclusions

There are eight federal and 15 provincial Acts or policies that either directly or indirectly affect the management of Alberta wetlands. Much of this legislation is contradictory and has resulted in a complicated web of competing policies that is confusing for regional and provincial agencies as well as for the public. The problem is often further complicated by poor communication among the many agencies and organizations whose activities directly or indirectly affect wetlands. Management of Alberta wetlands could benefit from cohesive legislation, as the result of the development of integrated, provincial wetland management policy.

## Conclusions

**S**ure, wetlands are important to wildlife. The really interesting questions are: How important are wetlands to us? And, what are we going to do about it? (Monte Hummel, World Wildlife Fund Canada).

In Alberta, wetlands are a significant component of the provincial land base. They meet a remarkable number of environmental, economic, and social needs: moderating watershed hydrology, helping control floods and soil erosion, providing valuable habitat for plant and animal species, supplying hay, pasture, and water for livestock, and offering a broad range of research, education, and recreation opportunities. They also fulfill societal needs for open space and landscape esthetics.

Historically, however, wetlands have been regarded as marginal resources whose benefits are best realized by conversion to other uses. This perception exists primarily because of lack of knowledge about wetland functions and benefits. The wide dispersal of wetland benefits makes recognition of their resource value particularly difficult. The result is that wetland conversion to other uses does not appear to carry a cost.

Part of the problem in maintaining the wetland base is the difficulty in deriving means of assigning value to wetlands functions and benefits. This is because most wetland benefits are not fully or adequately priced in the market place. Consequently, traditional economic assessment procedures such as benefit-cost analyses, are difficult to apply. The inadequacies of these assessment procedures has meant that many good wetlands have been converted or

altered to other uses simply because their value could not be adequately demonstrated.

Complicating the problems associated with wetland value is a range of federal and provincial legislation, policies, and programs that often indirectly and unintentionally encourage wetland conversion to other uses.

In view of the many benefits derived from wetland functions, sustainable use of Alberta's wetland base is highly desirable. To achieve wetland conservation and preservation, a provincial wetland policy could be developed that has as its principal objective maintenance of the wetland component of Alberta's land base through informed management.

A number of discrete, but interdependent actions need consideration, including: implementation of a provincial wetland inventory and evaluation ranking system; establishment of a lead agency; development of a public awareness program; and development of a wetland management policy with corresponding, enabling legislation.

An inventory and evaluation of wetlands in Alberta is needed to establish a database on which long-term planning and land management decisions can be made. The general inventory of wetland distribution, type, and abundance in the White Area of Alberta needs to be expanded to include wetlands in the Green Area.

There is also need for a detailed site-specific inventory and evaluation of wetland importance to include wetlands in both the Green and White areas. A ranking scheme that categorizes relative wetland significance according to wetland function is needed to help address particularly difficult planning and management decisions.

Wetland benefits need to be considered in a comprehensive way so that a balanced forum to address land use trade offs with other resource sectors is possible.

The component approach developed by the Ontario Ministry of Natural Resources could be adapted for Alberta and used in conjunction with the integrated multifunctional approach developed by the Canadian Wildlife Service and Wildlife Habitat Canada.

The evaluation scheme chosen could be used to identify and establish important wetland complexes for Alberta watersheds and river basins. Management plans could be developed for securing wetland complexes that would allow for appropriate wetland uses while maintaining renewable wetland values. A wetland complex approach would ensure management of not only large, permanent wetlands, but also the smaller, more vulnerable wetlands.

Particularly important to achieving sustainable wetland use is either the assignment of a lead agency or active coordination among the major responsible agencies to facilitate government action on wetlands. A lead agency would help to ensure a cohesive rather than fragmented problem-solving approach to wetland management and help overcome the problem of one agency's actions infringing on another mandate. Such centralization or coordination would also ensure a focus for public contact.

The responsibility for initiating, coordinating, and administering wetland programs so that they include wetland protection, conservation, drainage, and irrigation could be given to a lead agency. It would have the major task of promoting and facilitating the integrated use of wetlands by linking wetland management to other land-use and resource policies. This would help to ensure that wetland management becomes part of a comprehensive land-use strategy. The lead agency would be responsible for developing and gathering support from other government departments, industry, and the public for wetland objectives.

Another important objective of a lead agency would be to promote the development of a wetland ethic and to ensure that substantial information on wetland values was available. A lead agency could assume the responsibility for developing and implementing an awareness program, directed to other resource sectors, community, municipal councils and planning boards, and the general public. The objective of this program would be to overcome the current lack of knowledge on wetland functions. A parallel program in schools could be pursued.

At present, there is no assigned responsibility within government to inform the public about wetlands. Where questions concerning wetlands arise, several agencies may be involved, often resulting in public confusion.

The fundamental problem for wetland management is the lack of specific policy or strategy to ensure that wetland values are fully integrated in, and influential on, land-use and management decisions. There is an urgent need to develop and implement wetland use and management guidelines for land-use decisions at all levels of government. Paired with this is the need to establish a process for implementing wetland policy.

Also important is the clarification of government jurisdictional and legal responsibilities concerning wetlands as well as revision of government Acts, policies, and programs that are inconsistent with or at cross-purposes to wetland objectives.

Not all wetlands need to be preserved. The aim is to give equal consideration in planning and management decisions to both developed and undeveloped wetland benefits. All of these benefits should be considered in a comprehensive way and expressed as a provincial strategy for wetland management.

What is needed is a mechanism for pulling together expertise from different resource sectors and for facilitating public input toward the development of a wetland management policy for Alberta.

## References

- Acorn, J.H. 1987. "The Beetles of the Wagner Natural Area." *Terrestrial Arthropods. Newsletter, Biological Survey of Canada* 6:42-47.
- Adamowicz, W.L., W.E. Phillips, and W.S. Patisou. 1986. "The Distribution of Economic Benefits from Alberta Duck Production." *Wildlife Society Bulletin* 14:396-398.
- Alberta Environment. 1980. Cost Sharing for Water Resource Management Projects. Position Paper No. 5. Edmonton. 12 pages.
- Alberta Fish and Wildlife Division. 1987. *Alberta Fish and Wildlife Annual Review 1986*. Publication. No. 1/31-86. Alberta Forestry, Lands and Wildlife. Edmonton. 92 pages.
- Alberta Rice Growers Association. 1988. *Annual Report*. 9 pages.
- Alberta Water Resources Commission, Agriculture, Environment, and Forestry, Lands and Wildlife. 1987. *Drainage Potential in Alberta: An Integrated Study Summary Report*. Water Resources Commission. Edmonton. 163 pages.
- Bardecki, M.J. 1988. *Wetland Evaluation: Methodology Development and Pilot Area Selection*. Report to Environment Canada and Wildlife Habitat Canada. 114 pages.
- Bardecki, M.J., W.K. Bond, and E.W. Manning. 1988. Wetland Evaluation and the Decision-making Process. Paper presented to the International Water Resources Congress, May 1988.
- Bellrose, F.C. 1976. *Ducks, Geese and Swans of North America*. Stackpole Books, Harrisburg, Pa. 540 pages.
- Boxall, P.C. 1986. "The Use of Fish and Wildlife Resources by Non-Albertans: Sport Hunting and Fishing." Pages 23-32. In: *Proceedings of a Symposium on Tourism and the Environment*. Sponsored by the Canadian Society of Environmental Biologists. Edmonton. 127 pages.
- Brace, R.K. and G.W. Pepper. 1984. Impact of Agricultural Drainage on Wildlife. Paper presented to the Third Annual Western Provincial Conference on Soil and Water Management. 22 pages.
- Brown, R.J.E. 1977. "Muskeg and Permafrost." In: *Muskeg, The Northern Environment in Canada*. N.W. Radforth, ed. and C.O. Brawner. Toronto: University of Toronto Press. Pages 148-163.
- Canadian Wildlife Service and Wildlife Habitat Canada. 1988. *Wetlands Are Not Wastelands*. Pilot study interim report. 12 pages.
- Cowan, W.F. 1982. The Values of Wetlands to Society. Unpublished report prepared for Ducks Unlimited, Biological Services Group, Winnipeg. 23 pages.
- Davis, S.N. and R.J.M. DeWiest. 1966. *Hydrogeology*. New York: John Wiley and Sons, Inc.
- Dejardins, R. 1983. The Impact of Obstacles on Farm Operations. Resource Economics Branch, Alberta Agriculture, Edmonton. 82 pages.
- Ducks Unlimited Canada. 1989. *Wet and Wild Forages*. Brochure 12M, C/F. Canada.
- Environment Canada. 1981. *Wetlands of Canada*. Ecological Land Classification Series No. 14. Canada Committee on Ecological Land Classification.

- Environment Canada. 1986. *North American Waterfowl Management Plan*. Canadian Wildlife Service Report. Ottawa. 37 pages.
- Farber, S. and R. Costanza. 1987. The Economic Value of Wetlands Systems. *Journal of Environmental Management* 24:41-51.
- Federation of Ontario Naturalists and Environment Canada. 1987. *Wetlands Conservation Policy in Canada: Recommendations by Non-Government Organizations*. Result of a workshop, February 1987. 9 pages.
- Fillon, F.L., F.S. Parker, and E. DeWors. 1988. The Importance of Wildlife to Canadians — Demands for Wildlife to 2001. Environment Canada and Canadian Wildlife Service. Ottawa.
- Fillon, F.L. and S.A.D. Parker. 1984. *Human Dimensions of Migratory Game Bird Hunting in Canada*. Canadian Wildlife Service. Occasional Paper 51. Ottawa. 34 pages.
- Fillon, F.L., S.W. James, J.L. Ducharme, W. Pepper, R. Reid, P. Boxall, and D. Tellet. 1983. *The Importance of Wildlife to Canadians: Highlights of the 1981 National Survey*. Canadian Wildlife Service, Minister of Supply and Services Cat. No. CW66-62/1983. 35 pages.
- Golet, F.G. 1976. "Wildlife Wetland Evaluation Model." In: *Models for Evaluation of Freshwater Wetland*. J.S. Larson, ed. Water Resources Research Centre, University of Massachusetts. 4 pages.
- Goodman, A.S. and S.P. Pryor. 1972. A Preliminary Study of the Methods and Rates of Alteration of Waterfowl Habitat in the Black Soil Zone of Western Canada. Unpublished report prepared for the Canadian Wildlife Service. Edmonton. 77 pages.
- Gosselink, J.G., E.P. Odum, and R.M. Popy. 1974. *The Value of the Tidal Marshes*. Centre for Wetland Resources, Louisiana State University. Publication No. LSU-Sb-74-03.
- Hanus, F. 1974. *Role of Birds in Recreational Activities of Saskatchewanians*. A Report of Research for the Canadian Wildlife Service, Institute for Northern Studies, University of Saskatchewan. Saskatoon. 239 pages.
- Hillman, G.R. 1987. *Improving Wetlands for Forestry in Canada*. Information Report NOR-X-288. Northern Forestry Centre, Canadian Forestry Service. Edmonton. 29 pages.
- Hydrogeological Consultants Ltd. 1978. *Management of Groundwater Resources in Alberta*. Edmonton: Environment Council of Alberta. 205 pages.
- International Union for the Conservation of Nature and Natural Resources (IUCN). 1980. *World Conservation Strategy*. Gland, Switzerland. 46 pages.
- International Union for the Conservation of Nature and Natural Resources (IUCN). 1987. *The Ramsar Convention, Convention on Wetlands of International Importance Especially as Waterfowl Habitat*. Brochure. Prepared by IUCN, Gland, Switzerland.
- Jahn, L.R. 1988. *Strengthening Procedures for Maintaining Wetlands*. Paper Presented at the National Symposium on Protection of Wetlands from Agricultural Impacts. Colorado State University, Fort Collins, Colorado.
- Jaworski, E. and C.N. Raphael. 1978. *Fish, Wildlife and Recreational Values of Michigan's Coastal Wetlands*. Department of Natural Resources, Land Resources Programs Division. Lansing, Michigan.
- Lands Directorate 1986. *Wetlands in Canada: A Valuable Resource*. Environment Canada, Minister of Supply and Services. Fact Sheet. 86-4.

## REFERENCES

- Millar, J.B. 1978. *Wetland Classification in Western Canada: A Guide to Marshes and Shallow Open Water Wetlands in the Grasslands and Parklands of the Prairie Provinces*. Canadian Wildlife Service. Report Series No. 37. Environment Canada. Ottawa.
- Ministry of Natural Resources, Wildlife Branch and Environment Canada, Canadian Wildlife Service, Ontario Region. 1984. *An Evaluation System for Wetlands of Ontario South of the Precambrian Shield*. Second edition. Toronto. 166 pages.
- Morgan J.P. 1985. *An Analysis of Landowner Attitudes Toward Techniques of Wetland Preservation in the Prairie Pothole District of Manitoba*. Unpublished thesis. Natural Resources Institute, University of Manitoba. Winnipeg. 113 pages.
- National Wetlands Working Group. 1986. "Canada's Wetlands: Maps of Wetland Regions and Distribution in Canada." *The National Atlas of Canada*. Fifth edition. Surveys and Mapping Branch Energy, Mines, and Resources Canada.
- National Wetlands Working Group, Canada Committee on Ecological Land Classification. 1987. *The Canadian Wetland Classification System*. Inland Waters/Lands Directorate, Environment Canada. 18 pages.
- Neave D.J. 1984. *Our Clients and Their Changing Expectations "Wildlife Habitat Canada and other Approaches"* Unpublished report presented to International Fish and Game Commissioners, Victoria. July 1984. 10 pages.
- Public Advisory Committees. 1986. *Prospectus for an Alberta Conservation Strategy*. ECA-86-PA/CS. Public Advisory Committees to the Environment Council of Alberta, Environment Council of Alberta, Edmonton. 78 pages.
- \_\_\_\_\_. 1990. *Alberta Conservation Strategy: Strategic Framework in Brief (Draft)*. ECA90-PA/CS-D1. Public Advisory Committees to the Environment Council of Alberta, Environment Council of Alberta, Edmonton. 19 pages.
- Rakowski, P.W. and D.R. Jurick. 1986. *A Review of Legislation to Determine Its Effects on Migratory Bird Habitat*. Habitat Management Section, Canadian Wildlife Service, Winnipeg. 108 pages.
- Recce, S.E. 1984. *Endangered and Threatened Wildlife and Plants: Piping Plover Proposed as an Endangered and Threatened Species*. Department of the Interior, Fish and Wildlife Service. Federal Register 49:44712-44715.
- Schick, C.D. 1972. *A Documentation and Analysis of Wetland Drainage in the Alberta Parkland*. Canadian Wildlife Service. Unpublished report. Edmonton. 15 pages.
- Schmitt, K. 1980. *Wetland Reconnaissance within the South Saskatchewan River Basin*. Unpublished report prepared for Ducks Unlimited Canada. 29 pages.
- Shay, J. 1982. "Wetland Protection in the 80's." Pages 19-25. In: *Ontario Wetlands Conference Proceedings*. Federation of Ontario Naturalists, eds., Don Mills, Ontario. 193 pages.
- Smith, B.S. 1986. "Fort Chipewyan and Resources of the Peace-Athabasca Delta." Pages 124-141. In: *Native People and Renewable Resources Management Symposium*. Sponsored by Alberta Society of Professional Biologists. Alberta Native Affairs and Canada Department of Indian and Northern Affairs. April 29 - May 1, 1986. Edmonton. 276 pages.

- Stewart, R.E. and H.A. Kantrud. 1971. *Classification of Natural Ponds and Lakes in the Glaciated Prairie Region*. U.S. Bureau Sport Fish and Wildlife Resource Publication. No. 92. 57 pages.
- Strong, W.L. and K.R. Leggat. 1981. *Ecoregions of Alberta*. Alberta Energy and Natural Resources. ENR Technical Report. T/A. Edmonton. 64 pages.
- Swanson, L.E. and R.L. Rothwell. 1986. "Thawing on Ground Frost on a Drained and Undrained Boreal Wetland Site." In: *Cold Regions Hydrology Symposium*. American Water Resources Association. July 1986. 6 pages.
- Swinerton, G. In press. *Parks and Outdoor Recreation*. Sector report for an Alberta Conservation Strategy. Environment Council of Alberta.
- Tarnocai, C. 1980. "Canadian Wetland Registry." In: *Proceedings: Workshop on Canadian Wetlands*. C.D.A. Rubec and F.C. Pollet, eds., Lands Directorate, Environment Canada. Ecological Land Classification Series No. 12. Ottawa.
- Tilton, D.L. 1978. *The Ecology and Values of Michigan's Coastal Wetlands, Phase III*. U.S. Fish and Wildlife Service, Region 3. Minnesota.
- Traveldata International. 1983. *1982 Alberta Travel Survey*. A nonresident visitor study. Summary Report Vol. I. Alberta Tourism and Small Business, Edmonton.
- Turner, B.C., G.S. Hochbaum, F.D. Caswell, and D.J. Nieman. 1987. *Agricultural Impacts on Wetland Habitats on the Canadian Prairies, 1981-85*. Trans. N.A. Wildlife and Natural Resources Conference 52:206-215.
- Weiss, P.J. 1982. *Waterfowl Habitat Preservation, The Potential Role of Federal and Manitoba Legislation*. Unpublished Master's practicum, Natural Resources Institute. University of Manitoba, Winnipeg.
- Werschler, C. and C. Wallis. 1987. *Status of the Piping Plover in Alberta*. Unpublished report to World Wildlife Fund Canada, 53 pages, plus maps.
- Weslow, D.V. and L.M. Weslow. 1983. *Number of Nest Sites and Characteristics of the Piping Plover in Central Alberta, 1974-1977*. *Bluejay* 41: 155-161.
- Western Producer (The)*. 1987.
- Whittaker, R.H. 1970. *Communities and Ecosystems*. Toronto: MacMillan Company.
- Wight, P. 1988. *Tourism in Alberta*. ECA88-PA/CS-S4. Environment Council of Alberta, Edmonton. 44 pages.
- Working Group on International Wetlands. 1988. *Draft Policy Guidelines for Financing Projects Affecting Wetland Ecosystems*. Report prepared for United States Department of the Treasury, Washington. D.C. 25 pages.
- Whyte Reynolds and Associates. 1988. *An Evaluation Of The Alberta Wild Rice Grower's Association*. Edmonton. 38 pages.
- Zittlau, W.J. 1979. *An Environmental Assessment of Agricultural Practices and Policies: Implications for Waterfowl Habitat Management*. Practicum, University of Manitoba. Winnipeg. 282 pages.
- Zoltai, S.C., F.C. Pollett, J.K. Jeglum, and G.A. Adams 1975. "Developing a Wetland Classification for Canada." Pages 497-511. In: *Proceedings, 4th North American Forest Soils Conference*. B. Bevnier and C.H. Winget, eds. Quebec: Laval University Press.



# About Our Logo



ENVIRONMENT COUNCIL OF ALBERTA

Over the past two decades, the logo of the Environment Council of Alberta has shown three overlapping triangles as representing the foundations of our environment: land, air, and water. These triangles also represent the three groups with which the ECA interacts: industry, government, and the public. The three triangles intersect to form a circle symbolizing the biosphere. The small triangle in the centre of the circle symbolizes these three groups joining together to work for the conservation of our environment.

In 1980, the overlapped triangle motif was used by the World Conservation Strategy to represent the three primary objectives of that document. The Alberta Conservation Strategy incorporated the triangle motif into its logo by overlaying the WCS triangles onto a three dimensional outline of Alberta. This combination of triangles with the readily identifiable outline of provinces, nations, and regions has marked conservation strategies around the world.

